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THE POSSIBLE ETIOLOGICAL RELATION OF CERTAIN BITING INSECTS TO THE SPREAD OF INFANTILE PARALYSIS[1]

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Nothing has as yet been definitely shown regarding the channels of infection in acute epidemic poliomyelitis (infantile paralysis), though much has been encountered of a suggestive nature in our earlier Massachusetts studies.[2]

Owing to the frequent histories of insect bites of various kinds, it

[1] A Report to the Massachusetts State Board of Health, October, 1911, briefly abstracted in the Monthly Bulletin of the Board for December, 1911, p. 358–360 (1912).

[2] LOVETT, R. W. The Occurrence of Infantile Paralysis in Mass. in 1907. Boston Med. & Surg. Journ., July 30, 1908.

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was deemed advisable that the entomological part of the field should be thoroughly investigated.

The writers, together, during the months of August, Septemb[er] October of 1911, visited the Massachusetts cities and towns [listed] hereunder, undertaking a careful and intensive study of the [insect] life and history in the environment of cases. With very few exce[ptions] all the cases in the various towns were located either in dirty, u[n]sanitary parts of the town, or were characteristically rural.

CITIES AND TOWNS VISITED

Date of 1st Visit	Towns	No. of Cases
July 30	Waltham	2
Aug. 13	Tewksbury	6
Aug. 15	Winthrop	3
Aug. 17	Woburn	14
Aug. 24	Somerville	10
Aug. 26	Newton	4
Aug. 30	Winchester	2
Aug. 31	Pocasset	2
Sept. 6	Hamilton	1
Sept. 6	Marblehead	1
Sept. 7	Marlboro	6
Sept. 16	Lowell	14
Sept. 16	Westford	1
Sept. 20	Roxbury	4
Sept. 25	Winchendon	1
Sept. 26	Fall River	13
Sept. 26	New Bedford	4

In attempting to discover and elucidate any connection between insects and the spread of acute epidemic poliomyelitis, there are a number of facts, which must be considered. Much that has already been learned from clinical and epidemiological investigations can be turned to account, not only to reduce the number of insects which might be suspected of transmitting this disease, but to also suggest certain *a priori* conclusions to be tested out, both in the field and by experimentation.

Perhaps it may be as well to outline briefly the data which suggest insects as carriers, as well as to enumerate such facts as appear significant from an entomological standpoint.

1. The sporadic occurrence of the cases; this is not easily explained on the basis of ordinary contact infection, at least in many instances.

2. The seasonal distribution of the disease which shows the [greater] incidence during the warmer months, when insects of all sorts are more prevalent.

3. The failure on the part of many investigators to ascertain that the disease spreads where a number of children are regularly in close contact, as it seems, from reports so far published, to be the exception rather than the rule for several in a family to contract the disease.

1. The characteristic rural nature of the disease, which is apparently [illegible] less prevalent in large cities where the proportion of insects to the human population is less than it is in more sparsely settled or in rural districts.

3. The fact that in towns in Massachusetts, where the disease has been most prevalent, the proportion of animals to the population is greater than in cities, where the disease is less prevalent. This in turn implies a larger number of biting and parasitic insects which affect man as well as the animals.

Number of animals assessed in twenty-five towns where the disease was *least* prevalent, i. e., in the larger cities and towns.		Total number of animals assessed in the twenty-five cities and towns where the disease was most prevalent, i. e., in the smaller cities and towns.	
Population	943,614	Total population	[illegible]
Total number of cows	11,160	Total number of cows	[illegible]
1 cow to 84.5 inhabitants		1 cow to 11 inhabitants	
Total number of horses	29,519	Total number of horses	[illegible]
1 horse to 32 inhabitants		1 horse to 14 inhabitants	
Total number of swine	3,288	Total number of swine	[illegible]
1 swine to 287 inhabitants		1 swine to 60.5 inhabitants	
Total number of fowls	41,887	Total number of fowls	[illegible]
1 fowl to 22.5 inhabitants		1 fowl to 1.75 inhabitants	
Total number of dogs	23,851	Total number of dogs	[illegible]
1 dog to 30.5 inhabitants		1 dog to 24.3 inhabitants	

These facts seem to point very strongly to an insect-borne disease. Other facts which bear out the supposition that the disease might be insect-borne are added, although they do not appear to be less easily explained in other ways, at least when considered separately. These are:

1. The greater incidence of the disease among children, which are more apt to be bitten by insects than are adults under ordinary conditions.

2. The apparent biennial recurrence in the incidence of the disease in localities where it has been epidemic. This, as will be seen from considerations presented later in the report, would seem to imply a secondary connection with ticks, if there be any foundation in the belief that there is a relationship between animal and human paralyses.

In addition to these data, there is a negative evidence afforded by the failure of investigators satisfactorily to account for the spread of acute poliomyelitis through the other channels of infection that are concerned in the dissemination of most infectious diseases in temperate regions.

It is apparent, therefore, that an investigation of the insect fauna associated with cases of the disease seemed advisable, with a view

TABLE I.

LIST OF THE BETTER KNOWN INSECT-BORNE DISEASES WITH THEIR CARRIERS.[1]

GROUP A. CHARACTERISTICALLY INSECT-BORNE.

Disease	Animal affected	Principal distribution	Carrier[2]	Group to which carrier belongs	Other ordinary sources of infection	Pathogenic organism
Rocky Mountain spotted fever	Man	Western United States	*Dermacentor venustus*	*Acarina*	None	
African tick fever	Man	South Africa	*Ornithodoros moubata, O. savignyi*	*Acarina*	None	*Spirochæta duttoni.*
Typhus fever	Man	Cosmopolitan	*Pediculus vestimenti*	*Hemiptera*	None(?)	
Sleeping sickness	Man	Equatorial Africa	*Glossina palpalis*	*Diptera*	None	*Trypanosoma gambiense*
Yellow fever	Man	American and African tropics	*Aedes calopus*	*Diptera*	None	*A spirochæte?*
Malarial fever	Man	Tropicopolitan	*Anopheles* spp. (sens. lat.)	*Diptera*	None	*Plasmodium* spp.
Filariasis	Man	Tropicopolitan	*Culex fatigans et al.*	*Diptera*	None(?)	*Filaria* spp.
Dengue	Man	Tropicopolitan	*Culex fatigans*(?)	*Diptera*		*A spirochæte?*
Phlebotomus fever	Man	Tropicopolitan	*Phlebotomus papatasii et al.*	*Diptera*	(?)	
Barbiero fever	Man	South America	*Conorhinus megistus*	*Hemiptera*	None	*Schizotrypanum cruzi*
Leishmaniosis	Man	Eastern tropics	*Cimex rotundatus, Cimex lectularius*	*Hemiptera*	None(?)	*Leishmania donovani*
Bubonic plague	Man, rat, ground squirrel	Nearly cosmopolitan	*Lamopsylla cheopus*	*Siphonaptera*	Probably other fleas and biting insects	*Bacillus pestis*
Surra	Horse	Asia, Africa	*Tabanus, Stomoxys, Hæmatobia*	*Diptera*	Probably other insects	*Trypanosoma evansi*
Nagana	Domestic animals	Central and Southern Africa	*Glossina* spp., *G. palpalis*	*Diptera*	None	*Trypanosoma brucei*
Filariasis	Various animals	Tropicopolitan	*Culex* spp.	*Diptera*	None(?)	*Filaria* spp.
Texas fever	Cattle	Southern U.S., S. Africa	*Margaropus annulatus*	*Acarina*	None	*Piroplasma bigeminum*
East Coast fever	Cattle	South Africa	*Rhipicephalus appendiculatus et al*	*Acarina*	None	*Piroplasma parvum*
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Typhoid fever	Man	Cosmopolitan	Flies, house-flies, *Musca domestica*?	*Diptera*	Infected food, water, etc.	*Bacillus typhosus*
Cholera	Man	Cosmopolitan	*Musca domestica*?	*Diptera*	Infected foods, water, etc.	*Vibrio cholerae*
Dysentery	Man	Cosmopolitan	*Musca domestica*?	*Diptera*	Infected foods, water, etc.	
Diarrhœa	Man	Cosmopolitan	*Musca domestica*?	*Diptera*	Infected foods, water, etc.	Several bacteria
Tuberculosis	Man	Cosmopolitan	*Musca domestica*?	*Diptera*	Infected food, dust, etc.	*Bacillus tuberculosis*
Septicæmia	Man, animals	Cosmopolitan	Bugs. Various predaceous and carrion-feeding insects	*Hemiptera, Coleoptera*, etc.	Contact through lesions	

Group C. Possibly Insect-Borne

Anthrax	Man, sheep, cattle, etc.	Widespread	Biting flies(?)	*Diptera*	Contact through lesions	*Bacillus anthracis*
Rabies	Man, dog, and other domestic animals	Cosmopolitan	Biting insects(?)		Contact through lesions	A *Rhizopod Protozoan*(?)
Pellagra	Man	Europe and North America	*Simulium* spp.(?)	*Diptera*	Ingestion of mouldy corn	*Aspergillus fumigatus*.(?)
Filariasis	Man		Mosquito; tick	*Diptera, Acarina*	(?)	*Filaria perstans*
Hookworm	Man	Europe and North America	*Musca domestica*	*Diptera*	Larvæ in skin from infected soil	*Ancylostoma duodenale*, *Necator americanus*
Blackwater fever	Man	Tropicopolitan	Ticks(?)	*Acarina*	(?)	
Relapsing fever	Man	Africa	Tick(?)	*Acarina*	(?)	*Spirochæta recurrentis* and *duttoni*
Beriberi	Man		*Pediculus capitis*(?)	*Hemiptera*	(?)	
Infantile Kala-azar	Man	India	(?)	(?)	(?)	*Leishmania donovani*
Bovine gall-sickness	Cattle		Tick(?)	*Acarina*(?)	(?)	*Anaplasma marginale*
Equine infectious anæmia	Horse	Europe, North America	*Stomoxys calcitrans*	*Diptera*	(?)	(?)
Heartwater	Sheep		*Amblyomma hebraeum*	*Acarina*	(?)	
Malignant jaundice	Dog		*Haemaphysalis leachi*	*Acarina*	(?)	*Leptospira icteroides*

[1] In addition to the diseases listed, there are a considerable number of other diseases which have been suspected [illegible] no group of insects which has been associated with the transmission of disease [illegible] suited to transmit infection have been examined with negative results.

[2] In the case of some widespread diseases other species [illegible]

[3] More rarely other species of *Musca* [illegible]

toward eliminating as many species of insects as possible, and at the same time ascertaining if any might seem of sufficient importance to warrant more detailed field work and experimental tests in the laboratory. In entering upon such an investigation one is naturally led to pass in review such insects or groups of insects as have been proved to be factors in the transmission of other diseases. So far as our present definite knowledge extends, the accompanying tabulation is submitted. (See Table 1.)

From Table 1 it will be seen that the following groups of insects have been implicated in the transmission of diseases among man and domestic animals, including also ticks, which are, of course, not true insects, but, owing to their similar habits and other characteristics, are usually dealt with by entomologists: Acarina, Hemiptera, Coleoptera, Diptera, Siphonaptera.

Of these, only the Acarina (ticks), Hemiptera (true bugs) and Diptera (mosquitoes, flies) are known to include specific carriers, that is to say, insects upon which the pathogenic organisms are parasitic and the presence of which is necessary for the organisms to complete their life cycle before they can again normally reënter their mammalian hosts. The members of the other groups, as well as a number of those belonging to the Diptera, are known to transmit some diseases casually or accidentally, simply by carrying the bacteria upon their bodies, feet or mouth-parts. Their relation is simply that of moving objects to which the bacteria may adhere, but they are nevertheless very commonly mechanical carriers for certain diseases, the organisms of which occur often in materials that they frequent. Most important among these is the common housefly, which is eminently suited to play a part in such transmission as it regularly feeds upon both food and fecal matter.

While it cannot be so stated definitely, it seems probable that practically all insect-borne diseases will be found to depend for their spread upon insects belonging to the groups enumerated in Table 1. These various groups exhibit much in common in their mode of life and a comparison of such facts, with what has been learned concerning the spread of anterior poliomyelitis, serves to eliminate many insects which by reason of their mode of life cannot be suspected as carriers. Still following the assumption that the disease is insect-borne, it is thus possible to curtail greatly the list of insects which would seem to require investigation.

Among the Hemiptera, the groups so far shown to contain species acting as disease carriers, all include either wingless insects (as bedbugs, etc.), or else large bugs of rather rare occurrence in our region, which are characterized by such painful bites (Reduviid bugs,

(kissing-bugs, etc.) that their presence could hardly be overlooked. The sporadic occurrence of the disease and its failure to spread mainly in infected houses, serves to eliminate the wingless species, and the failure generally to find a history of painful insect bites, shows that Reduviid bugs cannot be to blame.

The Coleoptera do not ordinarily frequent substances which contain bacteria and it is only in rare instances that they can cause infection by biting, and it is very unlikely that any species will ever prove to be specific carriers of any human disease.

The Diptera include the largest number, and far and away the most widespread and important disease carriers among insects. These group themselves from an entomological standpoint into several series.

Mosquitoes. These insects serve as specific carriers of such diseases as yellow fever, malaria and filariasis, and might readily be suspected in the present connection, since numerous species are common in all regions where acute epidemic poliomyelitis occurs. Malarial fevers and yellow fever occur normally in epidemic form, each associated with the presence of the particular species of mosquito which is necessary to the completion of the life cycle of the pathogenic organism. The mosquito obtains it from the blood of one patient, and later injects it into another person, after the life cycle has been completed within the body of the mosquito. The malarial organism is a well-known protozoan and its development within the body of its insect host is quite familiar, but the organism of yellow fever, is a filterable virus concerning which we know nothing definitely, except that a twelve-day incubation period is required in the mosquito before its bite becomes infectious to a second person. It will be noticed that this organism resembles the virus of anterior poliomyelitis in being filterable.

There are several facts associated with mosquito-borne diseases which are at great variance with some observed in studies of poliomyelitis. In the first place, yellow fever and malaria spread rapidly in infected districts and quickly involve a large percentage of the population unless rationally controlled, and this is to be expected from the universal abundance of the insect hosts and the great opportunities of infection enjoyed by them in the presence of a human case of the disease. Such is not true of poliomyelitis, for although this becomes truly epidemic, it is never disseminated so thoroughly and rapidly throughout a community. In the second place, adults are fully as apt to be bitten by mosquitoes as are children, yet poliomyelitis has been considered essentially a disease of childhood and young adult life. (This assumes equal susceptibility to infection at all ages, which

may, of course, not be the case; at the present time we have no means of knowing.) And thirdly, while the abundance of mosquitoes agrees to some extent with the distribution of the disease, the two are not so closely correlated as would be expected were mosquitoes the carriers of the infection. This will be more fully dealt with on a following page.

It would appear, therefore, that while the mosquito cannot be entirely ignored as a possible carrier of acute poliomyelitis, it is not open to great suspicion. Nevertheless, mosquitoes should be carefully collected during an entire season and continually kept in mind as a possible, but not probable, source of infection.

Another important group of Diptera concerned in the transmission of disease are various biting muscid flies commonly known as "tsetse flies." These belong to a single genus *Glossina*, and, as is well known, are the carriers of sleeping sickness in man and various trypanosome diseases among domestic animals. They are the specific alternate hosts of the various trypanosomata and thus, so far as we know, absolutely necessary to the spread of such diseases. These flies are not native to America, but there is one common biting muscid, the stable fly, *Stomoxys calcitrans* L., common to Europe and America, which is very closely related to the tsetse flies, both in structure and habits. It has been quite definitely associated with the spread of surra and may reasonably be suspected of transmitting any disease represented by organisms in the blood. As is mentioned later in this article, this fly has been found in the environs of practically every case of anterior poliomyelitis examined with this in view, and may quite possibly prove to be the insect responsible for its spread. So far as can be ascertained at the present time, the comparative abundance of this fly during the summer months coincides closely with the incidence of poliomyelitis, as the fly appears in small numbers early in the summer, and persists in increasing numbers until quite settled cold weather in the fall. Such a seasonal fluctuation has been observed in the disease, which appears in early summer, increases toward the early fall and then practically disappears during the late fall, winter, and very early spring. Such increase during the course of the season is not common to all insects, but is characteristic of such as have a short life cycle, permitting a number of consecutive broods to mature each season. It is, of course, also common to mosquitoes, house flies, etc., although less strikingly so in the case of mosquitoes. There is some discrepancy in the autumnal disappearance of the flies and the disease as the latter appears regularly to drop off a little sooner than might be expected. This seems easily explainable, however, on the basis of the lessened activity on the part of flies in cool weather, and the short

are spent outdoors by the children for the same reason, and because they are in school during a great part of the day soon after the first of September. It seems to us, therefore, that the fact cannot be ignored that the greatest seasonal expression of acute epidemic poliomyelitis agrees strikingly with the greatest growth of *Stomoxys* and the school vacation period when children of all ages live a comparatively out-of-door life in parks, in bathing, etc. There is one habit of *Stomoxys* which should receive consideration also. In feeding, it very regularly passes from animal to animal during a single feeding and the opportunities for it to transmit micro-organisms in a mechanical way upon its mouth-parts are thus greatly increased.

It thus appears impossible upon *a priori* grounds to rule out *Stomoxys* and a final decision must await the results of experiments now in progress in which an attempt is being made to transmit the disease among monkeys by means of *Stomoxys*.

It is interesting to note in connection with the above remarks on *Stomoxys*, that it may quite possibly be associated with the spread of equine infectious anemia. The initial attack of this disease usually occurs in July, August and September and no causal relation appears to exist between its incidence and such ordinary sources of infection as food, water or contact. It is a blood disease, not infectious through ingestion of the virus into the alimentary tract, but readily communicable by intravenous inoculation. Such conditions immediately suggest *Stomoxys*, or possibly, but less probably, *Hæmatobia*, or *Tabanus*, as carriers, especially since experiments with *Margaropus annulatus*, the carrier of Texas Fever, have given negative results.

Belonging to another closely related family, the Anthomyidæ, is a much smaller insect known as the horn-fly (*Hæmatobia serrata*) which exhibits biting propensities similar to those of the stable fly, but confines its blood-sucking almost exclusively to domestic animals. On this account it is almost entirely restricted to barnyards and pastures or more rarely to stables where the adults attack the animals and gorge themselves with blood. In visiting cases of anterior poliomyelitis during the summer of 1911 we have looked for this fly, but found it in the neighborhood in only a very few instances. This fact, coupled with its rare occurrence upon man, renders its association with poliomyelitis very unlikely.

There remain several other groups of biting Diptera: one of them, the horse flies (Tabanidæ) have been associated with several diseases of domestic animals. None are known to be specific carriers, but on account of their blood-sucking habits may carry the virus of disease in a casual way from one animal to another. It is possible that these Tabanidæ may also take part in the transmission of anterior poliomyc-

litis, especially as they have been found abundant in certain rural districts where epidemic poliomyelitis has occurred. The seasonal distribution of these flies is not exactly like that of Stomoxys, since the horse flies do not have such brief life cycles and their greatest abundance is rather in midsummer than in the early fall. If [illegible] should prove to be associated with poliomyelitis, then there is perhaps good evidence that neither Stomoxys nor Tabanus is a specific carrier, as the two are quite different insects and it would be very unlikely that the same parasite to affect both.

Another group, the Simuliidæ, includes small biting flies which sometimes appear in enormous numbers in certain localities, particularly in the spring of the year. In Europe one of these, *Simulium reptans* has been thought to transmit pellagra, but this suspicion has not yet been proved, and American investigators are inclined greatly to doubt it. The larvæ of these flies breed exclusively in swiftly running brooks, and the adults are on the wing mainly in the spring of the year, so that their association with anterior poliomyelitis would be very improbable, as poliomyelitis is not confined to such localities and its greatest seasonal incidence does not correspond with the seasonal abundance of these insects.

Among the midges, another extensive family of small flies, (Chironomidæ), which are generally innocuous, are a few species which suck blood. These are quite vicious biters and might perhaps be associated with the spread of poliomyelitis, although we have not been able to demonstrate their presence in the vicinity of many cases. Also, these flies are very small and rarely, if ever, bite animals, so that any infection from animals could not ordinarliy be due to them. They thus appear to be much less likely than mosquitoes as carriers of poliomyelitis, aside from the fact that they have never yet been associated with any disease.

Somewhat similar small flies belonging to still another family, the Psychodidæ, are blood-sucking in habits. These are included in the genus *Phlebotomus* and its allies, but they occur rarely, if at all, in our region, and need not be considered in the present connection.

The Siphonaptera, a group of small wingless epizoic parasites known as fleas, have been associated as casual carriers of bubonic plague and are known to be the most common agents in the transfer of this disease. They have been suggested by Conn [1] as the possible carriers of acute epidemic poliomyelitis, but their habits and seasonal distribution appear in no way to bear out such a supposition. Their relative abundance in summer and winter does not coincide with the incidence

[1] Rept. State Bd. Health, Connecticut, 1910–11 (1912).

the disease for the falling off of poliomyelitis in winter is far more appreciable than the lessened abundance of fleas. Also, fleas would tend to distribute the disease more generally throughout families than usually occurs, although they might, of course, account for its carriage to considerable distances through the migration of animals to which they might be attached.

It seems probable, therefore, that fleas play no role in the transmission of poliomyelitis.

There remains only one other important group of insect-like animals, the ticks or Acarina, which must be considered, as some of these have been shown to be specific carriers of several diseases both of man and domestic animals.

At the beginning of the present investigation it was suspected that ticks might quite likely be associated with the spread of acute epidemic poliomyelitis, and an attempt was made to determine the presence of these in the immediate environment of all the cases. It was also ascertained with as great accuracy as possible whether the patient had actually been bitten by these animals, or whether it could reasonably be supposed that he might have been. As the work progressed, it became increasingly difficult to formulate such a theory in accordance with the observed facts, however, and it had to be abandoned for the present. Nevertheless, one peculiarity has been observed in the recurrence of the disease in epidemic form which appears inexplicable on any other basis: there seems to be a well-marked tendency for a region where acute epidemic poliomyelitis has been abundant one season, to be comparatively free from the disease the following year but to show a well-defined epidemic the second season. Such a recurrence every other year is not always very pronounced, but is still noticeable, and if this is the expression of factors involved in the spread of the disease, seems to find no explanation except on the basis of infection carried by some insect which requires two years to mature. The commonest tick met with on domesticated animals in Massachusetts is *Amblyomma americanum*, and according to Bishopp[1] this tick usually requires two years to attain maturity in this region. It rarely affects man, and could thus hardly be the primary cause of human cases, even had we not failed to demonstrate its presence commonly about cases this summer. Several assumptions are therefore necessary to associate it with acute epidemic poliomyelitis, and, though these involve the matter in such great doubt, it seems worth while to outline briefly what these are:

That human cases are the result of infection from animals, at

[1] *Loc. cit.*, Sept. 20, 1911.

least such primary cases that form a nidus from which infection may later spread.

2. That, while the tick may be the general carrier of the disease among animals,[1] some other carrier such as *Stomoxys* is necessary to transmit the virus to human cases.

3. That the introduction of the disease into Massachusetts is so recent that there has not yet been time for it to become equally abundant each year. Such a condition of approximately equal annual incidence must necessarily come about finally, on the basis of the above assumption, as a result of hold-over cases, and of irregularities in the length of the life cycle of the tick.

One habit of this tick might throw doubt upon such an hypothesis, since unlike the cattle tick, *Margaropus annulatus*, *Amblyomma* drops from its host to molt and must frequently attach itself to several animals during its lifetime. If it remained attached to the same animal continuously as does the cattle tick, a biennial reinfection would necessarily result, since with Texas Fever fresh animals are infected by the Piroplasma parasite only through young or seed ticks hatching from eggs laid by infected female ticks capable of transmitting the disease to their offspring through the eggs which they deposit. In the light of Lounsbury's observations, however, such an objection loses its force.

Account of the Area Investigated

In the following short accounts of the towns visited during the summer we have endeavored to give only such data as appear to have a bearing upon the foregoing discussion.

Waltham. Population approximately 28,000.

Waltham is in Middlesex County on both sides of the Charles River, ten miles west of Boston. It is connected with Boston through Newton, both by trolley and by the Fitchburg division of the Boston and Maine Railroad. It is principally engaged in the manufacture of watches, although there is also a large cotton mill, a bleachery and dye works in the town.

[1] In this connection it is instructive to note that Lounsbury has shown that cattle piroplasmosis in South Africa which is transmitted by a tick (*Hæmaphysalis leachi*) is not transmissible until after a complete life cycle of the tick. Thus it is spread not by the larvæ from infected mother ticks, but only by those which, reared from eggs deposited by infected mother ticks, have passed through two preparatory stages and attained the adult condition. Here, contrary to what prevails in the spread of Texas Fever, recurrences of cases from individual infections are delayed till a complete life cycle of the tick has been undergone. If we have to deal with a tick having a two-year life cycle, such a fact is at least significant in relation to the apparent biennial fluctuation of acute epidemic poliomyelitis.

Only two cases occurred here, giving an incidence of .07 per 1,000, one in a very unsanitary house in the yard of which many *Stomoxys* were seen ten days after the patient became paralyzed.

TEWKSBURY. Population approximately 6,000.

Tewksbury is in Middlesex County between the Merrimack and Concord rivers, five miles southeast of Lowell and 22 miles northwest of Boston. It is connected with Boston by the Boston and Maine Railroad, and with the surrounding towns and villages by trolley. The population of the town proper, which is about 4,000, is principally engaged in agricultural pursuits and the manufacture of cotton machinery, but the State Infirmary with 200 inmates is also located in Tewksbury.

Six cases occurred here giving an incidence of 1 per 1,000; or 2 in the infirmary and 0.50 in the population of the town. One death occurred, in the infirmary, that of a child, a state ward. No sickness could be discovered among the animals on the Institution grounds, although several fowls died after the first case occurred. The cause of death of these fowls could not be ascertained. A child transferred from the institution to the Children's Institution, Boston, reported well at the time, boarded out in a family in Malden, later developed acute epidemic poliomyelitis. In this family another ward, a probable secondary case, developed a facial paralysis.

At the time of our visit on September 16th, all the cases reported from the institution had occurred. The usual domestic insects were observed, also an unusual abundance of *Stomoxys*, some of which were seen upon a screened enclosure in the grounds in which the children had frequently been placed before they were attacked.

WINTHROP. Population approximately 10,000.

Winthrop is in Suffolk County, five miles northeast of Boston, situated on a peninsula in Massachusetts Bay. It is a summer resort and to some extent frequented by transient visitors to an ocean beach, which borders the town on the east. It is connected with Boston by the Revere Beach and Lynn Railroad, and also by trolley.

Three cases occurred here, giving an incidence of .30. They were associated with the usual household insects, in addition to which small horse flies (*Tabanus*) were common along the beach frequented by the children and also reported in one house where a case occurred.

WOBURN. Population approximately 15,000.

Woburn is a small manufacturing town in Middlesex County, ten miles northwest of Boston, whence many trains of the Boston and

Maine Railroad run daily, passing through Winchester, Somerv
and several other towns, and connecting with the line for Lowel
Winchester. Trolley cars run from Woburn through Winchester
Boston, and also connect it with Lowell. The principal industry
the tanning and manufacture of leather, and the refuse from th
establishments is disposed of in open fields about the town. A settl
tank from one tannery forms a public nuisance near the central p
of the town, occupying a field about which are ranged at least four
the cases of epidemic poliomyelitis.

The town is a thickly settled center with three outlying villages,
and an area occupied by a small rural population. The central portion
is connected with the metropolitan sewer system, and obtains its
water supply from Horn Pond, a large body of water upon the outskirts of the town proper.

In this town of 15,000 inhabitants 14 cases were discovered (an
incidence of practically 1 per 1,000 of population), two deaths, or
about 14% fatal. The homes of the cases in this and other towns
mentioned later we visited and investigated thoroughly. A detailed
analysis of all the cases will later be made in a general report of the
year's work. In the environment of each case, biting flies, mosquitoes
and the ordinary series of domestic insects were observed. In one
case in a typically rural district an epidemic disease among pigs,
characterized by paralysis, was reported earlier in the season than the
date on which the case of acute epidemic poliomyelitis occurred in
the child. In this neighborhood were a number of the stable flies and
a few house flies.

In another case situated in the town proper, within 20 yards of the
railroad yard a cat was reported to have been paralyzed before the
child took the infection. Some biting flies were discovered on the
house. A second case had its origin in the immediate neighborhood

SOMERVILLE. Population approximately 77,000.

Somerville is in Middlesex County, situated as are Woburn and
Winchester in the Mystic Valley. It is very intimately connected
with Boston by the Boston and Maine Railroad and by seven lines of
electric cars. Much of the teaming and railroad traffic between
Boston and Woburn, Winchester and Lowell passes through Somerville
in both directions. Its activities are mainly of an urban character,
including various manufacturing industries.

Ten cases occurred in this town, an incidence per 1,000 of approximately .13. The usual series of domestic insects were observed in
the environment of these cases, including *Stomoxys*. In one case
history was obtained that one month before the attack in July

child was stung between the shoulders by a strange insect, about eight o'clock in the evening, and at the same time an adult member of the same family was bitten in the same way. The sting was accompanied by a very sharp pain and was probably the bite of some species of *Tabanus*, although it may possibly have been *Stomoxys* or some other biting insect. Two horses were kept in a dry clean stable at the rear of the house.

No sickness or disease among domestic animals was discovered. In two instances the fathers were teamsters, and in one, two older boys in the family were also teamsters. Another home was situated on a dirty, narrow court open to a freight yard of the Boston and Maine Railroad where various cars were stored at the time of our visit.

NEWTON. Population approximately 40,000.

Newton is in Middlesex County seven miles west of Boston, on the Charles River and the line of the Boston and Albany Railroad. It contains the residences of many persons engaged in business in Boston, and is thus in close contact with the latter both by railway and road traffic, while to the westward its railroads and highways pass on to Worcester and Springfield. Its industries are varied, including the manufacture of foundry products, paper, print cloth, boots and shoes, glue, dyes, ink and soap. A part of the town is quite rural in character.

Four cases occurred here, giving an incidence of 1.00 per 1,000. In one case, which occurred on the outskirts of the town, several cows were reported to have been lame in the hind quarters two months before the child was taken sick. These cows belonged to a dairy and were pastured in a field adjoining the house where the patient lived, and frequently escaped into the back yard of this house. No further information concerning the cows could be obtained and they had presumably recovered completely.

In the house occupied by a second case in the thickly settled residential part of the town, a cat was kept, but had not been sick. Associated with each case was the usual series of domestic insects, including mosquitoes and biting flies.

WINCHESTER. Population approximately 9,000.

Winchester is in Middlesex County, eight miles northwest of Boston on the line of the Boston and Maine Railroad, not far from Woburn. It is also connected with Woburn, Lowell, and Boston, as well as with other nearby towns, by frequent trolley service. It is principally engaged in tanning and the manufacture of furniture, parts of the town being well settled, but the rest quite sparsely populated.

Two case occurred here, giving an incidence of .22 per 1,000 of popu-

lation. The first case was located on the main thoroughfare along which the trolley cars from Woburn pass, and situated only a block or two from the railroad which goes through Woburn. No definite connection could be traced with any case in Woburn, although the family traveled to and fro between Woburn and Winchester. In the second case a similar history was obtained, and the child was said to have eaten bananas purchased in Woburn. On the premises of both these families *Stomoxys* was seen in abundance. No sick animals could be found in the neighborhood.

Pocasset.

Pocasset is a village or a section of the town of Bourne. It is a small summer resort in Barnstable County on the eastern shore of Buzzards Bay. Its resident population is 208, but is greatly augmented during the summer months.

Two cases occurred in this town, one among the permanent inhabitants and another in the family of a summer resident from Brockton, Mass. The usual domestic insects characteristic of such a maritime town, including mosquitoes, *Stomoxys* and small horse flies (*Tabanus*) were seen on the premises of the second case. The first case originated much earlier in the season, known to us at the time of our visit, but not reported until afterwards.

Hamilton. Population approximately 1,750.

One case occurred in this small rural community, giving an incidence of .57 per 1,000. The father was a coachman on a neighboring estate and had been in close contact with his employer's child, who did not contract the disease. Mosquitoes and biting flies were present on the premises, the latter quite abundantly so.

Marblehead. Population approximately 7,000.

Marblehead is in Essex County, 18 miles northeast of Boston, three miles east of Salem, and four miles northeast of Lynn. It is situated on Massachusetts Bay and by reason of this location is a yacht center and summer resort. Its industries are mainly the manufacture of shoes. With Boston it is connected by the Boston and Maine Railroad, and with the neighboring towns, including Hamilton, by trolley lines, as well as by considerable traffic on the highways.

The single case which occurred in this town developed at Marblehead Neck, near the apex of the peninsula, some distance across the water from the town, in a family from Salem summering there. A case of earlier incidence was reported from Salem. It could be

closed with no other case in any way, although a later case reported elsewhere may have originated in Marblehead.

Insects, except mosquitoes, houseflies and *Stomoxys*, were not seen, although an insect described as resembling a tick had been seen on the infant and had bitten it, before the symptoms of poliomyelitis developed. *Stomoxys* had been killed in the patient's bedroom.

MARLBORO. Population approximately 14,000.

Marlboro is in Middlesex County on the Fitchburg division of the Boston and Maine Railroad, and also on the line of the New York, New Haven and Hartford Railroad. It is engaged mainly in the manufacture of boots and shoes, half of its 7,000 wage earners being engaged in this industry.

Three cases occurred in the town proper, in the families of which the fathers were operatives in these factories. In one family in which four cases occurred, the father was a farmer and the locality typically rural and well removed from the town. In this latter family two deaths occurred, and one of the cases, a girl 13 years of age, had suffered a previous attack of poliomyelitis ten years ago, when an infant three years of age. The question of second attacks will be treated of in another paper.

Stomoxys was unusually abundant about the premises and barnyard of this farm, and was also seen in the house and in the bedrooms with the patients.

LOWELL. Population approximately 106,000.

Lowell is in Middlesex County at the junction of the Merrimack and Concord rivers. It is connected with Boston by the Boston and Maine Railroad and by trolley lines, both passing through Somerville and Winchester, and is also connected with Woburn by electric cars.

It is a manufacturing town, engaged mainly in textile industries, although it also contains many foundries and machine shops, and some boot and shoe factories. Its population, therefore, consists in great part of the lower working classes, living in rather closely settled districts surrounded by more sparsely peopled rural communities.

Fourteen cases occurred in this town, an incidence of approximately .15 per 1,000 of population. The usual series of domestic insects were observed in the environment of these cases, including *Stomoxys*. In one case a cat became paralyzed at about the same time that the child was paralyzed, and this child had played with the cat intimately. The cat was driven out of the neighborhood and could not be found at the time of our visit.

At least six cases in the city occurred later, several of which were in

the immediate neighborhood of the above case. It is interesting to note that nearly all of these cases were distributed along the principal artery of traffic between Woburn and Lowell, and situated either on or near enough to the main thoroughfare to be within easy fly-distance of it—that is, if biting flies are shown to be carriers of the infection, it is not unreasonable to suppose that infected flies may have followed horses or have been carried on vehicles coming from Woburn to Lowell. The distance of the cases from the main thoroughfare was not in excess of their ordinary range of flight. In several other cases animals were discovered, but no sickness among them. The father of one case, a milkman, delivered milk in a family where a case later developed.

WESTFORD. Population approximately 3,000.

Westford is in Middlesex County on the Boston and Maine Railroad six miles southwest of Lowell and 33 miles northwest of Boston. It is composed of six smaller villages whose population is engaged mainly in agriculture.

Only one case occurred here, on a small farm situated in a district with sparse rural population, giving an incidence of .33 per 1,000. Mosquitoes were present and also *Stomoxys* in the patient's bedroom and upon the front door screens and exterior of the house.

WINCHENDON. Population approximately 6,000.

Winchendon is in Worcester County, situated on the Miller River, 18 miles northwest of Fitchburg and 36 miles north by west of Worcester. It contains three villages, and, although in part quite thickly populated, is entirely destitute of any system of closed municipal sewers. It is principally engaged in the manufacture of woodenware, toys, cotton goods and wood-working machinery.

Only a single case occured here, several miles from the town on the country highways between Winchendon and Royalston. Since that time a case has developed in the latter town, but has not yet been investigated by us. The house where the child was taken sick is in a very rural district, just across a small brook from an establishment where old rags are sorted for use in a shoddy mill. The premises were very dirty and unsanitary, and suffering from a plague of mosquitoes and flies, both house flies and *Stomoxys*. Near the house is a large depression, previously dry for some years, but this season dammed and filled with water.

FALL RIVER. Population approximately 119,000.

Fall River, which is in Bristol County, is an important railroad centre, and also a port of entry which thus suggests a possible im-

...of the infection from abroad by immigrants or from other American ports. This city is on the Rhode Island border, on the eastern shore of Mount Hope Bay, the northeast arm of Narragansett Bay, and the Taunton River, 20 miles from the sea. It is intimately connected with Boston and Providence, and the intervening districts by railways, and there is much interurban traffic carried on with Taunton, New Bedford and Newport, R. I., also. From Boston it is 48 miles distant, but from Providence only 20 miles.

Fall River is a typical city of small manufactures, employing nearly 25,000 operatives in the production of cotton goods which form its principal industry. It is rather densely populated in parts, but covers a large area, embracing over 40 square miles and including many spalid districts. In these, most of the cases occurred. The water supply is derived from Watuppa Lake, a body of water ten miles in ...gth on the eastern side of the city. It has a good system of sewers, ...r, owing to the character of a great part of its population, is not as ...eanly as might be desired.

NEW BEDFORD. Population approximately 96,000.

New Bedford is a manufacturing town in Bristol County, near the mouth of the Acushnet River. It is on the line of the New York, New Haven and Hartford Railroad, 56 miles south of Boston, and is connected with New York City and the islands of Vineyard Sound by a regular steamboat service. Its industries are largely the manufacture of cotton goods, and in this trade nearly all of its wage earners are engaged.

Four cases occurred in this city, an incidence of approximately ...ne per 1,000 of population. The usual series of domestic insects were observed in the environment of these cases, including *Stomoxys*. One adult case, female, 35 years of age, a mill hand, reports that the ...ecessor loom fixer, who lived within a block of her home, had a child sick and unable to walk for three weeks. No diagnosis was obtained in the case of the child, nor was it reported as a case of poliomyelitis.

It may be stated, then, in a general way for all cases where *Stomoxys* was seen, that this fly was observed in the house, on the house, on the ...ses and barns; and occasionally in the patient's bed chamber.

Fourteen cases occurred in this town, an incidence of approximately ...ne per 1,000 of population. The usual series of domestic insects were ...ed in the environment of these cases, including *Stomoxys*. In ... every case domestic animals were seen and in four of these ... in cats was reported. One case in the city gave a history of ... age cat straying into the house and being petted a good deal by the ...ild. The cat later died, and within six weeks of this cat's

death the child became sick and was paralyzed. Another case in the rural district, Meridian St., was found to have Herpes Zoster complicating acute epidemic poliomyelitis. The father, a teamster in business for himself, kept four or five horses in the stable at rear of house. *Stomoxys* was unusually abundant here, as were also mosquitoes, but no sick animals. The child had marks of bites on his body. A month before the attack the family were living at a nearby home. The child was often placed on the horses' back and led around the grounds. An interesting case in an adult male, 73 years old, was seen, which gave a history of bites by stable flies, followed in a week by febrile attack and paralysis of one arm.

Summary

Nothing absolutely definite has hitherto been ascertained regarding the channels of infection of acute epidemic poliomyelitis.

Many facts connected with the distribution of cases and the spread of epidemics of this disease together with histories of insect bites suggest at least that the disease may be insect-borne.

Field work during the past summer together with a consideration of the epidemiology of the disease so far as known, points strongly toward biting flies as possible carriers of the virus. It seems probable that the common stable fly (*Stomoxys calcitrans* L.) may be responsible to a certain extent for the spread of acute epidemic poliomyelitis, possibly aided by other biting flies such as *Tabanus lineola*. No facts which disprove such a hypothesis have as yet been adduced, and experiments based upon it are now in progress.

If the disease should prove to be common to any species of domestic animals, as is now strongly suspected, a secondary connection of ticks in spreading the disease among such animals seems probable, as has been mentioned earlier in this paper.

From the investigation during 1911 it has become apparent that if acute epidemic poliomyelitis is an insect-borne disease, there must exist some factors in its spread which are as yet far from clear, and from the knowledge so far gained, apparently more complex than those involved in most of the insect-borne diseases hitherto elucidated.

The relation between human paralysis and animal paralysis or kindred diseases, is as yet very imperfectly understood, and it seems possible that studies along this line, if undertaken from an entomological standpoint, might serve to advance our knowledge concerning the spread of acute epidemic poliomyelitis in man.

THE ACTIVITY OF PROSPALTELLA BERLESEI HOWARD AGAINST DIASPIS PENTAGONA TARG. IN ITALY

Diaspis pentagona Targ., or the white scale of the mulberry, was first observed in Italy by Professor Targioni Tozzetti of Florence upon some branches of mulberry which were sent to him from communes in the province of Como (Proserpio, Asso, Canzo). They were mentioned in a letter dated May 10, 1886 addressed to Prof. Franceschini and published in the Rivista di Bachicultura, volume VIII.

Since that time *Diaspis pentagona*, only feebly antagonized by adverse indigenous conditions and by the activity of the agriculturists, has spread with an increasing rapidity and occupies almost all the centers of mulberry culture in Italy, and certainly all of north Italy. We have then all of north Italy infested, together with a good part of central Italy, and centers of infestation in south Italy.

Targioni was the first to suggest, in 1892, that *Diaspis pentagona* was of Japanese origin, and now every one holds this opinion. The species was described for Japan by Sasaki, of Tokio, in 1894, under the name *Diaspis patelleformis*, and for Australia by Tryon in 1889 under the name *Diaspis amygdali*. In America it was described by Morgan and Cockerell in 1892 under the name *Diaspis lanatus*.

The spread of this species in Italy reached such proportions that the Italian government was obliged in 1891 to promulgate a law against the Diaspis, compelling tree owners in infested localities to fight the insect by mechanical means (scraping the trunk and the infested branches, pruning, sterilizing by fire), and by insecticidal solutions. In spite of these expensive measures, the ravages of the scale were not sensibly diminished, and its rapid and intense propagation apparently could not be stopped by artificial means.

In this deplorable state of affairs *Prospaltella berlesei*, reared by Professor Berlese from *Diaspis amygdali* from America and described by Doctor Howard, was introduced into Italy. As early as 1902 Professor Berlese thought that the great spread of this species in Italy was due to the lack of natural enemies which held it in check in its native country. Considering that all of the Diaspine scales are energetically attacked by internal parasites (which destroy at least 90 per cent) and that *Diaspis pentagona* had no parasite in Italy, he supposed that there must be in some part of the world an especial enemy of this species which could fight it in Italy as well as in its native country.

In the month of May, 1906, Professor Berlese received the first

living individuals of *Prospaltella berlesei* How. from the United S[illegible] whence they had been sent by Doctor Howard's kindness. He libe[illegible] them at Milan; in 1908 he was able to obtain the same species [illegible] Japan, and these individuals were liberated at Genoa, at Casale [illegible] ferrato, and at Milan (Vanzago), at Caserta, and at Pisa.

At Genoa the parasite was liberated in small numbers (perhaps [illegible] thirty) upon a mulberry tree which was one of a series of eleven [illegible] broad-branched trees badly infested by the Diaspis.

In December, 1909, and in January, 1910, the Diaspis had alm[illegible] entirely disappeared from these mulberries, and almost all the fem[illegible] were found infested by the Prospaltella. Two thousand section[illegible] branches were cut off and distributed in the north of Italy.

At Vanzago the small number of parasites put out in 1908 upo[illegible] mulberry tree in the middle of about thirty others on the lands [illegible] Sig. Vago had given rise in March, 1909, to a very slight progen[illegible] In July of the same year the percentage of parasitism was more tha[illegible] eighty, and already the scales on the neighboring trees were attacked by the Prospaltella. At the end of 1910 this little parasite unaided was propagating itself upon all of Mr. Vago's mulberries, and even upon neighboring lands, abundantly infesting the Diaspis on three rows of mulberries of more than thirty trees over a space of 2000 square meters. Professor Berlese cut off 600 pieces of infested branches. He estimated then that the increase of the Prospaltella from April, 1908, to April, 1910, had progressed as from 1 to 5000; that is to say seventy times yearly.

The increase of the Diaspis from one year to another is much smaller, and Berlese has calculated that four years will suffice to destroy this most injurious scale over all of Italy by the aid of the Prospaltella.

Deducting the material from the nurseries at Genoa and Vanzago, there were established in 1910, by the aid of traveling professors of agriculture, societies, co-operatives, schools, municipalities, the following centers of distribution of Prospaltella:

Liguria	57
Piedmont	600
Lombardy	809
Venetia	700
Emilia	55
Marche	60
Umbria	40

About a hundred branches were sent to places outside of Italy, [illegible] others to Locarno, from which no late news has been received.

Here are the results obtained at the end of the year 1911, according to the account of Professor Berlese, who has himself visited the localities in upper Italy where mulberries are cultivated:

The region in which the spread of the precious parasite has been the most effective and the most efficacious, thanks to the indefatigable efforts of the traveling professors of agriculture, is upper east Italy. We have already said that in 1910 four hundred pieces of branches were sent to this region. In 1911 the number was increased to 1160. The destruction of the Diaspis by the parasite has been so intense that this region will be the first to be cleared of the scale. In some localities, especially at Vincenza and at Verona, where the Prospaltella was placed in 1909, the multiplication has been such that they already claim the total destruction and disappearance of the Diaspis as the result of the work of the parasite.

Brilliant results have been obtained by Professor Orsi in the suburbs of Riva, where centers of spread of the Prospaltella have been established since 1908.

The most marvelous results have been noticed in the centers of spread established in 1910. Here one finds the Diaspis still on the bark, but all destroyed by the parasite.

Professor Berlese visited Lombardy also, where the most perfect centers of spread were found at Vanzago and at Venegono Inferiore. At Vanzago upon the estates of Cav. Vago he was not able to find a healthy Diaspis, but only traces of the scale killed by the parasite. Around this estate the Diaspis was found to a distance of several hundred meters, but always infested by the Prospaltella, which had spread unaided. Professor Berlese estimates that in 1912 all the Diaspis will be destroyed for a distance of several kilometers from the center.

In 1911, 7614 branches carrying the Prospaltella were distributed in Italy, and this is the list of localities to which this infested material was sent:

Liguria	210
Piedmont	1218
Lombardy	2784
Venetia	2812
Emilia	254
Marche	196
Umbria	50
Tuscany	90

The great success obtained in the work against the Diaspis by the use of Prospaltella is due to certain peculiarities of this parasite.

The Prospaltella, like all special or general internal parasites, does not attack a single particular individual scale, but searches continually and actively until the last individual is found and oviposited in. The scale is attacked at all ages—larva, nymph, and adult, but the females especially are parasitized. This is of especial importance from the point of view of economy of the forces of the parasite. The destruction of the males would be worth little, for the Diaspis is parthenogenetic; the Prospaltella is also parthenogenetic—the males of this species are not even known. So the reproductive forces are not wasted in the production of males which would be useless in destroying the Coccid. This precious parasite is very active and prolific, having four or five generations a year, each female carrying about one hundred eggs in its abdomen. Professor Berlese has been able to find no enemy or disease of the Prospaltella except predaceous insects.

One of the most striking characteristics of the Prospaltella is its migratory power, which helps enormously in its spread. Emigration takes place during the hot season, and the insects will fly to relatively great distances in order to lay their eggs, and often pass over walls, hedges, ditches and other obstacles. The early and late generations are lazier and remain near the birth place.

After his inspection trip to verify the results of the parasitic work, Berlese has reported the following conclusions:

(1) *Prospaltella berlesei* is perfectly adapted to the climate of upper Italy. It multiplies most actively in the milder regions (Genoa, Lac de Garde) rather than in the colder regions (Piedmont) where it has probably one or two generations less.

(2) Excessive cold is not injurious to the parasite.

(3) The diffusive intensity of the parasite is so great that it will disperse throughout upper Italy even without being aided artificially. Professor Berlese prophesies that during 1912 Liguria and Venetia will be for the great part freed from the Diaspis, and that the same condition will be reached for Lombardy in 1913 and for Piedmont in 1914.

(French abstract by Dr. Caterina Samsonoff; English translation by L. O. Howard.)

STOP-BACK OF PEACH

E. E. A. Back and W. J. Price, Jr., *Virginia State Crop Pest Commission, Blacksburg, Virginia*

For many years, nurserymen have been troubled by a disease of peach nursery stock known as "Stop-back" resulting in the death of the tender terminal bud of the principal shoot. The injury to the terminal shoot forces the development of lateral shoots, the terminal buds of which may in turn be affected in a similar manner. When this trouble is spreading at its greatest rapidity, not a single terminal, and even many of the lateral buds, of both the principal and lateral shoots are killed and the plant remains dwarfed and fails to develop into a tree designated by the nursery trade as X No. 1. Frequently the trees are so stunted by the successive deaths of the terminal buds that they are absolutely worthless. Many trees, however, are only sufficiently affected to make them undersized and very crooked, and while they may make as good trees for orchard planting, they must be sold at a price which means a substantial loss to the nurseryman a loss that in 1911 in Virginia amounted to about $5,000, and in Pennsylvania to about $15,000.

From time to time, various creatures have been said to cause this Stop-back. Prof. M. B. Waite in a paper before the Biological Society of Washington during 1897 stated that a mite was responsible for the injury. In 1896, Prof. W. G. Johnson noted many stunted peach trees during his inspection work in Maryland and upon examination, found a minute mite associated with the trouble. Dr. J. B. Smith in 1899 believed that Stop-back in New Jersey was caused by "Peach Thrips."

Prof. W. B. Alwood of the Virginia Agricultural Experiment Station, who had observed Stop-back since 1891, considered Thrips responsible for the injury. Mr. J. L. Phillips, formerly of this Commission, in the fifth report of the Virginia State Entomologist, stated that he considered that mites were the causative agent. Messrs. Webster and Mally, in an article on "Insects of the Year in Ohio," read in August, 1899, stated their belief that Stop-back was due to the work of the common tarnished plant-bug, *Lygus pratensis* L., since they found no mites present and the extent of injury to peach in proportion to the abundance of the bug. Prof. A. L. Quaintance in a paper on "The Peach Bud Mite" published as part six of Bulletin 97 of the U. S. D. A., B. E., Feb. 1912, states that a mite is apparently responsible for Stop-back. He has had the mite in question identified by Mr. Banks as *Tarsonemus waitei* Banks, and discusses its systematic relationships, and of the allied economic species of mites belonging to the same family,

Tarsonemidae. Those interested in this malady of peach nursery ... are referred to the above mentioned bulletin by Prof. Quain... which contains besides valuable observations, excellent descrip... and illustrations, a reference to previously published articles a... resume of their more important statements.

The purpose of this article is to give what the writers consider ... nite proof that Stop-back of peach in Virginia, at least, is not ca... by the tarnished plant-bug, *Lygus pratensis* L. So far as is know... reliable data has been given to fix the responsibility on either *Tar...mus waitei* Banks or *Lygus pratensis* L. To quote from Prof. Quaint...

"Prof. Waite's careful observations, and those of Messrs. John... Phillips, and others, indicate clearly that the *Tarsonemus waitei* is th... cause of the so-called "stop-back" affection of peach nursery stock. It may also be true that injury practically identical in effect on the tree... is caused by thrips, as stated by Dr. Smith and Prof. Alwood. Young thrips, principally *Euthrips tritici*, are very commonly found in the tender growing tips of various kinds of vegetation, and are especially common on peach nursery trees. In blocks of trees infested with the mite, the thrips larvae have been found by the writer in great abundance, but never, so far as could be determined, killing the tips of the shoots. The writer is inclined to the belief that the injury in Ohio, New Jersey, and Virginia (as shown by Phillips) is due to the *Tarsonemus*, its small size, agility, and habits contributing to its oversight. Any injury to the growing tip of a peach shoot, as by plant-bugs, would naturally produce a similar effect in causing the cessation of growth and the development of lateral shoots, but the comparative scarcity of such insects in injured blocks in the territory under consideration does not warrant their association with the trouble."

To be considered with the above statements, the following are offered:

In early May, 1911, the senior writer was notified that "Stop-back" was at work in a nursery near Richmond. He was not able to make an examination until about June 10th, at which time he was told that the trouble was not spreading much. A very large percentage of the peach trees were affected. No insect was sufficiently abundant to attract special attention, but tiny mites, thrips and *Lygus pratensis* were collected. *Lygus pratensis* was observed sucking the juices from terminal buds, but was not in sufficient numbers to appear to be responsible for the wholesale injury. All things considered, mites, from their abundance, were thought most likely to have caused the injury. No further observations were made during 1911.

On May 8, 1912, information was received that Stop-back was beginning to appear in blocks of peach trees near Richmond. On May 21st, the writers visited the nursery in question and found that *L. pratensis* was abundant in sufficient numbers to warrant the ...

that they were causing the Stop-back. They were found sucking the sap from the terminal buds. There were noted perfectly healthy terminals from which bugs were sucking the sap, slightly and badly wilted terminals, as well as dried and blackened terminals. Close observation over a large area clearly indicated that *Lygus pratensis* was causing the damage. The injury was, generally speaking, in proportion to the abundance of bugs as previously noted by Webster and Mally in Ohio. In some instances, leaves close to the terminal bud were blackened as a result of the feeding of the bug while the bud itself was unaffected. Several hundred affected buds showing all stages of Stop-back were collected and of these, one hundred were examined by the senior writer in the laboratory and but one mite and three thrips were found. The bugs were noted to thrust their beaks into the tip of the tender shoots to their full length. Examination of shoots dying but not yet blackened, showed discolored streaks in the plant tissues corresponding in length with the beaks of the bugs.

An examination of the trees at 2 p.m., sun bright and hot, gave the results in Table I.

TABLE No. 1. RELATION BETWEEN NUMBER OF TREES AFFECTED AND ABUNDANCE OF THE TARNISHED PLANT-BUG

Block	Variety	No. Trees in row	No. Trees affected	No. bugs found per tree
No. I	Belle of Ga.	691	531	197
	Belle of Ga.	756	412	223
	Alexander	546	301	81
	Ray	669	292	56
	Globe Va.	694	397	
No. II	Albright's Winter	195	81	17
	Carmen	212	86	19
	Bilyeu's Late	184	72	15

In some instances, as many as seven bugs were found on one plant. As the insects flew from the plants on the slightest provocation, it is thought that the number counted was smaller than was actually present. On June 1st, the trees were again examined and over 99 per cent of the trees in Block No. I were found affected, and but four bugs were found on one row of trees as compared with 223 on May 21st. Had one only the observations made on June 1st to judge by, it would have been impossible to associate *Lygus pratensis* with the injury.

The injury as observed on May 21st, was so clearly caused by *L. pratensis* that cages made of cheese cloth stretched over wooden frames were placed over the trees in the nursery rows and the following observations made:

Cage No. 1. May 23, 3 p. m. Cage placed over three plants apparently free from injury. Nine specimens of *L. pratensis* were placed in cage.

May 24, 4 p. m. Terminal buds on all three plants wilted and show same injury as newly affected plants on outside.

May 25. Terminal buds of five lateral branches on tree No. 1; four on tree No. 2, and five on tree No. 3, affected.

May 26. Terminal buds of both main and lateral shoots have turned black.

May 27. All terminals affected. Injury identical with that of plants throughout nursery.

Cage No. 2. May 23, 3.15 p. m. cage placed over six plants which showed no injury. All *L. pratensis* excluded.

May 24. No injury apparent.

May 25. " "

May 27. " "

Cage No. 3. May 23, cage placed over nine plants; five of the nine plants plainly affected; four not affected. Dead terminal buds of affected plants carefully cut away. All insects excluded.

May 24. No new development of Stop-back.

May 25. No change.

May 27. Non-affected plants still unaffected and affected plants from which injured terminals were cut, show no further injury.

Cage No. 4. May 23, cage placed over seven plants; four affected, three not affected, all insects excluded and affected terminals not removed.

May 24. No change.

May 25. " "

May 27. No further spread of injury on affected plants, and non affected plants still uninjured.

Cage No. 5. May 25. Two very healthy non-affected plants caged and six bugs placed in cage. Tree No. 1 has main and 7 lateral shoots. Tree No. 2 has main and 16 lateral shoots.

May 27. On tree No. 1, terminal buds of main and six lateral shoots affected. On tree No. 2, terminal buds of main and twelve lateral shoots affected.

May 28. On both trees terminal buds of all shoots affected, and turning black.

Cage No. 7. May 28, cage placed over six plants, three affected, three not affected. Insects excluded.

June 1st. No further spread of injury, non-affected trees growing rapidly, with terminal shoots crowding against top of cage.

Cage No. 8. May 28. Cage placed over six non-affected trees and nine bugs added.

June 1st. All terminal and many lateral buds of both main and lateral shoots injured, showing characteristic appearance of Stop-back.

Although *Lygus pratensis* was disappearing from peach trees in Eastern Virginia by June 1st, it was found to be increasing in abundance on peach nursery stock at Blacksburg, where the season, due to an elevation of 2200 feet, is fully three weeks later. But few specimens of *pratensis* could be found at Blacksburg on May 24th. To prevent

typical Stop-back in the laboratory, six specimens of *pratensis* were placed in a rearing cage with seven shoots of peach on June 3rd. By June 7th, all shoots had developed typical Stop-back. The bugs were closely watched at intervals and were seen to puncture the terminal buds. Check shoots developed no Stop-back.

Stop-back has never been abundant enough to attract much attention at Blacksburg during past years. To produce typical Stop-back in a block of nursery trees showing but slight affection from this trouble, two cages were placed over trees after a manner similar to that at Richmond with the following results:

Cage No. 10. June 10. Caged five non-affected trees; all bugs excluded.

June 17. No Stop-back has developed.

Cage No. 11. June 10. Caged five non-affected trees; eleven bugs placed in cage.

June 13. Terminal buds of main shoots wilted.

June 17. No examination made since the 13th. All terminal buds of main shoots affected and blackened. Comparatively few terminal buds of the large number of lateral affected.

From the above experiments, the writers believe that there is no room for doubt regarding the causative agent of Stop-back of peach, at least in Virginia during the season of 1911 and 1912. The fact that they could produce Stop-back at will in field and laboratory by using *Lygus pratensis* and were never able to find *Tarsonemus waitei* in even what could be called slight numbers, at a time when the trees were being injured most, warrants this conclusion. And they believe that there is sufficient evidence in published statements to lead one to seriously doubt the conclusions drawn by others regarding *T. waitei*, unless very different conditions exist in other states.

The only experimental evidence thus far presented is that given by Mr. Phillips.[1] Since Mr. Phillips did not state whether he covered the plants about which he placed affected shoots, and since *L. pratensis* is known to occur at Blacksburg, there is no assurance that mites caused the subsequent injury. That too few specimens of *pratensis* have been found by observers to cause them to disregard it as the causative agent does not appear to have much weight, inasmuch as *pratensis* appears in large numbers in a comparatively short time, does its greatest damage and then largely disappears. Had the writers made their observations during June rather than May of this year, they would have been at as great a loss to know the cause of Stop-back as they were during 1911. Most growers, especially men who have charge of a large acreage, do not notice injury of the nature of Stop-back until it is far advanced and by the time an expert is called upon, the injury is done and the bugs largely gone. As in the examination of newly affected buds, no mites have been found while more

[1] 5th Report, Va. State Ent. & Plant Path., 1906, page 50.

have been found several weeks after the injury is first evident, indicates that the mites are either secondary or breeding only in the tissues killed by the bug.

Prof. Quaintance records the failure to discover any difference in affection during the summer of 1906 between peach stock sprayed with lime sulphur before the buds opened and unsprayed trees. He also states that notwithstanding the fact that one large nursery firm has sprayed peach trees for some years during the dormant period with a miscible oil used at full winter strength, its trees have suffered seriously from Stop-back. Rather than ascribe the failure of these sprays to the hibernation of the mites elsewhere, it would seem more likely to disregard the mites and attribute the failure of sprays mentioned to the presence of *Lygus pratensis* which is known to exist from Canada to Mexico, to be especially fond of tender peach growth, and on account of the ease with which it migrates from place to place, entirely unaffected by winter sprays.

No attempt was made to control *Lygus pratensis* on trees near Richmond during May, 1912, by the writers. Certain rows were sprayed with self-boiled lime sulphur by the grower but no difference could be observed in the abundance of bugs or of diseased trees several weeks later. Judicious pruning, advocated by Mr. Phillips, was found to be worthless during the period of greatest activity of *pratensis*, for as fast as a new shoot was formed, the terminal bud was at once killed. Some method of driving the bugs from the blocks of peach should first be tried, and be followed later by pruning after the majority of the bugs have disappeared.

Summary

Stop-back of peach in Virginia is caused principally by the tarnished plant bug, *Lygus pratensis*. This insect is present on peach stock in largest numbers only for a comparatively short time, although it causes some injury throughout the season. Unless one is present in the nursery when injury is taking place most rapidly instead of making examinations several weeks later, *Lygus pratensis* is easily overlooked as the causative agent. Mites in Virginia, presumably *Tarsonemus waitei*, but not determined, are absent from freshly killed terminal buds, but later may be found in numbers in the blackened decaying tips. In the nursery, the extent of injury from Stop-back was found, in general terms, to be in proportion to the abundance of *Lygus pratensis*. In eleven cage experiments carried on in the field, no Stop-back developed in any cage from which *Lygus pratensis* was excluded, while all or many shoots developed Stop-back in cages into which specimens of this bug had been introduced.

SOME FURTHER NOTES ON THE WHEAT-HEAD ARMY-WORM

Meliana albilinea Hubner

By R. L. Webster

A few additional observations have been made by the writer on this insect in Iowa since the publication of Bulletin 122 of the Iowa Agricultural Experiment Station, as well as a brief paper in the Journal of Economic Entomology.[1] In order to make these a matter of record they are brought together in this article. The notes used for this paper represent work done at the Iowa Agricultural Experiment Station at Ames.

Early in 1911 it looked as if this pest might again become common. Adults were noticed rather numerous at lights in May, being captured on the 14th, 21st and 23rd, of that month at Ames. They were most common May 21. In June I found larvae common in several places in Iowa, but they did little damage.

Parasites

Proterthron retorridum Girault MS. This tiny egg parasite was reared abundantly in the fall of 1910, emerging from eggs from August 30 to September 14. One lot of parasitized eggs, collected at Pocahontas, in northwestern Iowa, harbored these parasites through the winter in the insectary cold room, these emerging April 16. All of these were males, winged and wingless; the winged forms predominating. 52 individuals were counted here, and only 32 eggs, so there must have been some eggs with more than one parasite.

From another lot of eggs, collected September 13 at Corwith, Iowa, these parasites emerged September 14. This is probably about the limit for the fall emergence of the insect, since the lot collected September 16 wintered over in the host eggs.

Microgaster auripes Prov. In the fall of 1910 several white parasite cocoons, exactly like those of this species, were placed in a cage in the insectary cold room. No Microgasters emerged from these cocoons, however, only a species of *Mesochorus* (H. L. Viereck determination) coming out. I have previously recorded the former species as a parasite of the wheat-head army-worm.

Apanteles solitis melianae Vier. Since the publication of Iowa station bulletin 122 on the wheat-head army-worm Mr. H. L. Viereck has

[1] Journ. Econ. Ent. vol. iv. p. 179.

[2] Proc. U. S. Nat. Mus. vol. 40. p. 185. 1911.

named and described this parasite. The species was reared from cocoons collected in several Iowa localities in the summer of 1910. From cocoons collected in October and kept in the insectary cold room, the adults emerged in March 1911.

Mesochorus nigrisignis Vier. This insect, also recently described by Viereck,[1] is a secondary parasite on *Microplitis melianae*. Only two specimens have been reared, one August 8, 1910, the other April 16, 1911. In the latter case the parasite spent the winter in the insectary cold room within the cocoon of its host.

Omorgus sp. A single parasite, so determined by Mr. H. L. Viereck, emerged May 5, 1911 from an insectary cage in which a number of wheat-head army-worms were placed the October before. It has presumably some relationship to that insect, but what this may be is entirely a matter of conjecture.

NOTES ON SAPERDA CALCARATA SAY IN SOUTH CAROLINA

By Wilson P. Gee

Saperda calcarata is one of the largest of our native species of the very destructive genus Saperda, and cases where it has been reported its damage seems to have been of a rather severe nature. The notes available on the life history of this form are exclusively northern or eastern in their application, and since there is a difference in these localities and this of a couple of months in the emergence of the adults, these few observations have been considered as of sufficient value to be made available for general use.

On April 20, 1912, investigation was made of a reported outbreak of a poplar borer at Whitmire, S. C., with the result that some 1,200-1,400 handsome Carolina poplars (*Populus deltoides* Marsh) were discovered to be almost hopelessly infested with *Saperda calcarata* Say. The attention of the mill authorities at this place, on whose property the trees were found, was directed to this damage only after several trees had broken off, a distance of some seven to nine feet above the ground. Examination revealed the fact that practically the entire lot of ten-year old trees were in a condition to be similarly mutilated upon being subjected to heavy winds.

The distribution of this species is quite general east of the Rocky Mountains according to Felt (Monograph of the Genus Saperda. New York State Museum, Bull. 74), who reports having seen speci-

[1] Ibid, p. 192.

ner from as far south as Texas and South Carolina. According to Felt "the adult makes a small slit in the bark and deposits its eggs underneath the surface." In many places along the trunk patches of dead bark were observed, the removal of which showed the old marks of the larvæ having bored in the inner bark and outer sap-wood some months before. From these places large openings leading to irregular galleries through the outer sap-wood and into the heart were observed. In the trunks of the broken trees careful cutting showed only well advanced pupæ at this date. A conservative estimate would place the number of such pupæ found in one tree examined with this end in view at about sixty within a distance of four feet in length of the trunk. In Albany, N. Y., Felt states that in early June he has found pupæ, but no beetles bred therefrom until into July. From pupæ gathered on the above mentioned date, April 20, and placed, some of them in sawdust well moistened, the others remaining in the wood brought in, beetles were bred out May 6, a couple of months ahead of the emergence period reported from New York. This wide difference in the emergence period between New York and South Carolina is perhaps to be explained as the cumulative effect of the higher average temperatures of this locality, shortening the life cycle by some sixty days or more. The completion of the life history is recorded by Felt as requiring three years.

The pupæ found were in cells well toward the centre of the tree. Felt in describing the pupal chamber of this form says, "the top is smoothly cut and the other end is packed closely with coarse fibres which are attached to the side of the gallery at one end, and the portion next the pupa is packed with much finer borings and then coated with very fine sawdust." The accompanying figure, plate 8, shows a pupa *in situ*.

The damage done by this form consists in its weakening effect on the trunk of the tree, together with the fact that it spoils the wood of the tree for uses as lumber. Digging out the borers is an impractical proposition, since the irregular galleries extend well in toward the heart of the tree. The control measures necessarily are the application of repellent washes during the breeding season, or some caustic wash applied at frequent enough intervals during the breeding season to destroy the eggs or newly hatched larvæ.

INSECTS AND SPIDERS IN SPANISH MOSS

(Some Additional Data)

By A. H. Rosenfeld, *Tucuman, Argentine Republic*

In the "Journal of Economic Entomology," Vol. IV, No. 4,[1] the writer gave a list of a large number of insects and spiders collected in Spanish Moss during the winter of 1908–09 and the summer of 1909. All of this moss was collected at Mansura, in the Aroyelle's Parish, which is located near the centre of the State of Louisiana.

Having records of the examination of one additional lot of moss, which was taken just across the river from Baton Rouge, La., shortly after the boll-weevil appeared in the Parishes of East and West Baton Rouge, it has been thought well to publish these also. This moss was collected on January 26, 1910, by Prof. Wilmon Newell, the insects and spiders listed, representing the quantity taken from a lot of 14 1-4 pounds.

The methods of examination of these lots, and of the calculations were described in the article above mentioned. As with the other lots, all insects found in this moss were living, and in the adult state, unless otherwise mentioned. Acknowledgments are due to the same gentlemen as were mentioned in the preceding article on this subject. The results of these examinations are given in the following table:

January 26, 1909, 14.5 lbs. Tillandsia usneoides

INSECTA

Species	No. found in Lot	Approximate No. per lot.
Paromius longulus	18	2,484
Blattid, immature	8	1,104
Megilla maculata	5	690
Nysius californicus	3	414
Phalacrus penicellatus	3	414
Anthonomus suturalis	2	276
Gryllid, immature	2	276
Harmostes fraterculus	2	276
Ceutorynchus sp.	1	138
Chalybion caeruleum	1	138
Elaphidion parallelum	1	138
Entylia sinuata	1	138
Haltica ignita	1	138
Largus succinctus	1	138
Lixus musculus	1	138
Scymnus collaris	1	138
Total Insects	51	7,038

[1] Pages 398–409 inclusive.

ARACHNIDA

Cl[illegible]anthium inclusum	5	690
Philodromus diversus	4	552
Dendryphantes octavus	3	414
Argy[illegible]me sp. (young)	2	276
Grammonota maculata	2	276
Oxyopes scalaris (young)	2	276
Marcus interfector (young)	1	138
Xysticus piger (young)	1	138
Total Spiders	20	2,760

Remarks on Insects

In this lot of moss we find that there were 16 genera and species of insects as compared with 24 and 26, respectively, from the same quantity of moss taken from Mansura on January 27, 1909, the nearest comparative date. The actual number of insects, however, taken in the Mansura lot, was considerably greater than from the lot taken near Baton Rouge.

Eleven of these species occurred in the winter lots of moss collected at Mansura, nine of which were in the lot collected January 27. Among these are *Paromius longulus* and *Xysius californicus*, which occurred in all of the winter lots taken at Mansura, and, also, *Phaenus penicellatus*, *Anthonomus suturalis* and *Lixus muscalus*, which occurred in five of the six winter lots from Mansura.

The five species collected which had not been previously recorded from the moss, were *Megilla maculata*, *Chalybion caeruleum*, *Elaphidion parallelum*, *Entylia sinuata* and *Scymnus collaris*.

Remarks on Spiders

Of spiders we find that there were eight genera and species, or the same number as was found in the Mansura moss of January 27. The actual number of individual spiders taken was also about the same as the number taken from the Mansura lot of comparative date. Six of these spiders had been collected from other winter lots, four being recorded for the lot of January 27.

The two species which had not yet been taken from moss were, *Cl[illegible]anthium inclusum*, and *Xysticus piger*. Two species, *Philodromus diversus* and *Grammonota maculata*, had occurred in six of the previously recorded winter lots, and one, *Dendryphantes octavus*, had occurred in four.

Proceedings of the Second and Third Annual Meetings of the Pacific Slope Association of Economic Entomologists

Owing to an extended absence from the State on the part of the Secretary, the proceedings of the Second Annual Meeting of the Pacific Slope Association of Economic Entomologists was not published and is here given only in part.

The second annual meeting occurred March 31st and April 1st, 1911, in Berkeley at the University of California in affiliation with the newly organized Pacific Association of Scientific Societies. The Entomology Building served as headquarters for the members. The following extracts are taken from the minutes of the meeting.

Friday, 9.30 a.m., March 31, 1911

Altho a preliminary business meeting had been arranged for 11 o'clock, this was postponed in order to attend the special University meeting held at this hour.

Friday, 1.30 p.m., March 31, 1911

The meeting, convening in the lecture room of the Entomology Building, was called to order by Professor C. W. Woodworth, President of the Association.

On motion of Secretary Herms, seconded by Mr. J. T. W. De Jong, a special business session was called for 7.30 p.m. of that day.

The following papers were then read and discussed.

1. "Some Insect Pests of California Oaks," by Professor R. W. Doane, Leland Stanford University. (Appears in this number of the Journal.)

2. "California Redwood attacked by Termes flavipes Koll.," by W. B. Parker, U. S. Dept. of Agriculture, Bureau of Entomology. (Pub. in Journal of Economic Entomology, Vol. 4, No. 5.)

3. "Development and Life History of Red Scale (*Chrysomphalus aurantii* Mas[illegible]) Professor H. J. Quayle, University of California. (See Bulletin 222, University of California Experiment Station.)

4. "The Leakage Problem in Fumigation." Professor C. W. Woodworth, University of California. (Pub. in Vol. 4, No. 4, Journ. of Economic Entomology.

5. "The Fructification of the Fig by Blastophaga." C. P. Rixford, U. S. Dept. of Agriculture, Bureau of Plant Industry. (Appears in this number of the Journal.)

6. "How long do Hymenopterous parasites live" (read by title). Prof. [illegible] B. Doten, University of Nevada. (See Technical Bulletin No. 78, Agr. Exp. Sta. Univ. of Nevada.)

7. "Field Work in Argentine Ant Control." L. J. Nickels, University of California. (Pub. in Vol. 4, No. 4, Journ. of Economic Entomology.)

Recess until 7.30 p.m.

Friday 7.30 p.m., March 31, 1911

Meeting called to order by President Woodworth, reading of reports having been made a special order.

a. Report of President, by Professor C. W. Woodworth.

b. Report of Secretary-Treasurer, by Professor W. B. Herms. The secretary reported a membership of fifty-eight. The receipts of the Association amounted to $60.95, disbursements $63.30, bills due $30.00, making a deficit of $32.35. The deficit is so large owing to the expense of stationery and preliminary matters of organization. Dues are being well paid up.

A discussion of the financial condition of the Association brought out the fact that the annual dues for 1911 would certainly wipe out the deficit and leave the treasury in good condition. Thru the immediate payment of dues on this same evening the matter was almost cleared up at once.

A discussion of ways and means for the publication of annual proceedings was entered into at this time. The Secretary announced that Dr. E. P. Felt, Editor of the Journal of Economic Entomology, had offered the services of that Journal.

Motion made and seconded that the Association accept with thanks the offer of Doctor Felt and instructing the Secretary to correspond with him relative to printing the proceedings in one issue of the Journal. Motion carried unanimously.

Motion carried to proceed with program for the evening.

8:00 p.m. Symposium on the Scope of Economic Entomology as practised on the Pacific Coast from the viewpoint of:

The Horticultural Commissioner, Hon. H. P. Stabler, Yuba City.

The Insecticide Manufacturer, Mr. R. R. Rogers, San Francisco.

The Sanitarian, Prof. W. B. Herms, University of California. (Appears in this number of the Journal.)

The Educator, Prof. C. W. Woodworth, University of California.

Motion made by Mr. H. P. Stabler and seconded by Mr. L. J. Nickels that a copy of Professor Herms' paper on "Economic Entomology from the Viewpoint of the Sanitarian" be forwarded to the San Francisco papers for publication. Motion carried.

Saturday, 9.00 a.m., April 1, 1911

Motion made and carried that the regular order of business be set aside and that the President appoint a nominating committee to report immediately after the morning's program.

The President appointed the following members to constitute the nominating committee, viz., Professor R. W. Doane and Mr. A. L. Rutherford.

Reading of papers proceeded as follows:

8. "Some Coccid parasites in California." Professor H. J. Quayle, University of California. (See Bull. 222, 223 and 226, University of California Experiment Station.)

9. "The Quantity of Spray required." Professor C. W. Woodworth, University of California.

10. "Chalcids which feed at Punctures made by the Ovipositor." Professor S. B. Doten, University of Nevada. (See Technical Bull. No. 78, Agr. Exp. Station, University of Nevada.)

11. "The Distribution of Ecto-parasites." Professor V. L. Kellogg, Leland Stanford University. (Abstract appears in this issue of the Journal.)

12. "Anti-Malaria Campaigns in California, methods and results." To be published together with other material in book form, "Malaria, cause and control."

The nominating committee reported the following nominations:

President,—Professor C. W. Woodworth, Berkeley, California
State Vice-Presidents,—
Arizona, —— ——, Phoenix
British Columbia, Hon. Th. Cunningham, Vancouver
California, Professor R. W. Doane, Palo Alto
Colorado, Professor C. P. Gillette, Fort Collins
Idaho, Professor L. F. Henderson, Moscow
Montana, Professor R. A. Cooley, Bozeman
Nevada, Professor S. B. Doten, Reno
New Mexico, Professor Fabian Garcia, Agricultural College
Oregon, Professor A. B. Cordley, Corvallis
Utah, Professor E. D. Ball, Logan
Washington, Professor A. L. Melander, Pullman
Wyoming, Professor Aven Nelson, Laramie
Executive Committee,—
Mr. R. R. Rogers, San Francisco
Mr. H. P. Stabler, Yuba City
Mr. L. H. Day, Hollister
Mr. G. H. Jackson, Monrovia
Secretary-Treasurer,—W. B. Herms, Berkeley, California

The secretary was instructed to cast a ballot for the election of the officers.

After a discussion of the time and place of the next meeting,

matter was left in the hands of the Secretary and adjournment took place.

Third Annual Meeting of the Pacific Slope Association of Economic Entomologists

The Third Annual Meeting of the Pacific Slope Association of Economic Entomologists took place at Stanford Univeristy, California, April 5th and 6th, 1912, in affiliation with the Pacific Association of Scientific Societies. The Entomologists had their headquarters in Room 432, Zoölogy Building.

Friday Morning, April 5th, 1912

11.00 to 12.00 Business Meeting. The Society was called to order by the President, Professor C. W. Woodworth. The minutes of the last Annual Meeting were read and approved. On motion the President appointed the following committees:

Auditing committee comprised of Professor R. W. Doane, Mr. G. A. Coleman and Mr. D. L. Crawford. Nominating committee consisting of Professor H. J. Quayle, Mr. J. C. Bridwell, Mr. E. O. Essig

After announcements by the Secretary the Association adjourned to meet at 1.30 p.m.

Friday afternoon, April 5th, 1912

Motion carried that we proceed to carry out the program as printed.

The President called upon Professor Doane to occupy the chair. The chairman called for the first paper on the program "The Insecticide Industries in California" by Professor Woodworth. After reading his paper the President again resumed the chair.

The following papers were read and discussed:

1. "The Insecticide Industries in California." Professor C. W. Woodworth. (Appears in this issue of the Journal.)
2. "Studies of the Petroleum Fly (Psilopa petrolei Coq.) in California." Mr. D. L. Crawford, Leland Stanford University. Published in full in Pomona Journ. Ent. Vol. IV, No. 2, pp. 687–97.)
3. "Diabrotica virgifera Lec. as a Corn Root worm." Professor C. P. Gillette, University of Colorado (Read by Professor W. B. Herms). (Appears in this issue of the Journal.)
4. "A new Genus of Coccidæ destroying the Sugar Pine." Mr. George A. Coleman, University of California.
5. "Photographing Insects with demonstration of apparatus in the photography of the Entomological laboratory." Professor R. W. Doane, Leland Stanford University.

Friday Evening, April 5, 1912

At six-thirty the members of the Association present met at the Hotel Palo Alto for dinner together with the Biological Society of the Pacific Coast. After dinner an informal round table was indulged in, during which informal, chiefly reminiscent, talks were given by Doctor A. J. Cook, Professors Woodworth, Doane, Herms, Doctor McCracken, Mr. Bridwell and others.

The dinner and round table were voted a success and the secretary's plan to make this affair a regular part of the program for the future was approved.

Saturday morning, April 6, 1912

Meeting called to order by the President. The paper on "Hippodamia convergens and the Canteloupe aphis in the Imperial Valley" was called for. This paper was omitted yesterday owing to the absence of Mr. Bridwell.

After the presentation of the above paper the regular program was resumed, viz.:

7. "New Laboratory Apparatus." Professor C. W. Woodworth, University of California.

8. "The Chemistry of phenolic insecticides." Mr. G. P. Gray, University of California.

9. "Entomological Field Notes." Mr. J. C. Bridwell, University of California.

Owing to the advanced hour the meeting adjourned for luncheon to meet at 1.30 p. m. for the completion of the program and other business.

Saturday afternoon, April 6, 1912

Motion made and carried that the completion of the program be deferred until after the transaction of business.

A brief verbal report was made by the President, Professor C. W. Woodworth.

The Secretary-Treasurer reported a membership of 63, an increase of five during the year. The finances of the association were reported very much improved, the deficit of $32.35 having been wiped out with a balance of $7.15 in the Treasury.

The Auditing committee reported the accounts of the Secretary-Treasurer in good order and entries correct.

The report of the Nominating committee was read and the secretary was instructed to cast a ballot for the following officers:

President,—Professor R. W. Doane, Palo Alto
Six Vice-Presidents,—
Arizona,—— ——
British Columbia, Hon. Th. Cunningham, Vancouver
California, —— ——
Colorado, Professor C. P. Gillette, Fort Collins, Moscow
Idaho, Professor L. F. Henderson
Montana, Professor R. A. Cooley, Bozeman
Nevada, Professor S. B. Doten, Reno
New Mexico, Professor Fabian Garcia, Agricultural College
Oregon, Professor A. B. Cordley, Corvallis
Utah, Professor E. D. Ball, Logan
Washington, Professor A. L. Melander, Pullman
Wyoming, Professor Aven Nelson, Laramie
Executive Committee,—
Mr. E. E. Luther, Watsonville
Mr. H. P. Stabler, Yuba City
Mr. J. C. Bridwell, Berkeley
Mr. G. H. Jackson, Monrovia
Secretary-Treasurer,—W. B. Herms, Berkeley

Motion made and carried that the Secretary be instructed to correspond with the Editor of the Journal of Economic Entomology relative to securing space in that Journal for the publication of the annual proceedings of this Association.

Motion made by President Doane and seconded by Mr. Morrill that the secretary be instructed to do all in his power to secure an international congress of entomologists for San Francisco for 1915, and that he correspond with Professor Vernon L. Kellogg, now in Europe, to that effect. Motion unanimously carried.

Motion made and carried that the Association extend a vote of thanks to the local committee on arrangements for efficient and kindly services rendered.

The remaining numbers on the program were then taken up, viz.:

[illegible] "Malaria Investigations,– Epidemiology and Prophylaxis." Professor W. B. Herms, University of California. (To be published in Book form together with other material, "Malaria, cause and control.")

[illegible] "Cleonus canescens Lec. as a Fruit Tree Pest." Professor C. P. Gillette, University of Colorado (Read by Professor W. B. Herms). (Appears in this issue of the Journal.)

[illegible] "Demonstration of Breeding Methods in Heredity Experiments in progress at Stanford University." (Room 447 Zoölogy Building). Doctor Isabel McCracken, Leland Stanford University.

The visitors were taken to a room where Dr. McCracken was carrying on breeding experiments with the silk worms.

[illegible] in laws of heredity.

Adjournment then followed.

W. B. HERMS, *Secretary-Treasurer.*

SOME INSECT PESTS OF THE CALIFORNIA LIVE OAKS

By R. W. Doane, *Stanford University*

(As this is a preliminary report on the study of the Oak pests, only an abstract of the paper is given here.)

During the past year the oaks in the Santa Clara Valley have been having a particularly serious time. The live oaks especially have suffered from the attacks of leaf-miners. In addition to the leaf-miners, the twig-girdlers have been doing a great deal of damage and the carpenter worms, which heretofore have been found only occasionally in old weakened trees, have this year developed into very important pests, killing some trees and very seriously injuring many more.

The Oak Tree Moth. The first serious outbreak of *Phryganidia* in the Santa Clara Valley occurred in the fall of 1894 and the spring of 1895 when, entirely without warning, the larvae appeared in astounding numbers and completely stripped all of the oak trees in the vicinity of Stanford University, appearing in less number at the same time in other parts of the valley.

Few parasites were noted in the first fall brood of the larvae; the following over-wintering brood were found to be rather badly parasitized; and the larvae and pupa of the next fall brood, the third of the outbreak, were so badly parasitized that but few reached the adult condition and the parasites than remained in control a number of years.

During the spring and summer of 1908 nearly all the trees in the vicinity of the University were again defoliated. In June 935 larvae and pupa were collected from a mass on an oak tree; 228 of these were parasitized by *Pimpla behrendsii* Cresson, 704 were killed by a bacterial disease and three adults issued. In October of the same year 1170 were collected in the same locality; 83 per cent were parasitized, 6 per cent were killed by a bacterial disease, 4 per cent reached the adult condition and 7 per cent died from undetermined causes.

The larvae attacked by the bacterial disease showed to a remarkable degree the tendency to mass together.

Tussock Moth. Instances almost as remarkable might be cited to show how the tussock moth is controlled by its parasites, principally the Tachina flies, although the small hymenopterous parasites and the Dermestes beetles also do important work.

The last serious outbreak of the tussock moth larvæ occurred in the spring of 1907.

Leaf-Miners. We have at least three species of leaf-miners infesting

the live oak. One has been called the "white blotch oak leaf-miner" on account of the characteristic white blotch on the upper side of the leaf. The larvae work only in the upper layer of cells, making a rather large irregular blotch in which they finally pupate after spinning a flat, loosely constructed web. Like other members of this genus, *Lithocolletes*, the larvae undergo an interesting change during development. The leaves of the white oak and the blue oak are attacked by the same species and sometimes seriously affected.

One of the other leaf-miners makes a long serpentine burrow which gradually grows wider as the larva increases in size. When it is full grown it drops to the ground and spins a small, rather closely woven brownish cocoon.

The other species, *Bucculatrix*, makes a dense brown blotch and a short serpentine mine which is distinctly visible on both sides of the leaf.

Part of the larval stage is spent as a miner and part as a surface feeder. The moult takes place under a circular white silken web on the under surface of the leaf. We have not yet determined the length of the different larval stages, but the typical ribbed *Bucculatrix* cocoons are made in May and June, the adults issuing a little later. The leaf-folders that simply fold over the edge of the leaf and the leaf-tiers that fasten two leaves together for protection while feeding, are often abundant enough to seriously affect the appearance of the tree, especially in May when the new growth comes.

Twig Girdler. During the last three years the California oak twig girdler (probably a species of Agrilus) has been increasing to an alarming extent. A few years ago the work of this insect was rarely noticed on the trees but now the beauty of many of our noblest trees is sadly marred. The larva evidently enters close to the tip of the twig in the tender new growth. At first it works in the center of the twig but as soon as it reaches the harder wood it works just beneath the bark in the cambium and sap wood. As soon as it enters the cambium it begins working down the twig in a spiral, thus effectively girdling and killing it.

As the larvae enter the twigs early in summer and work all winter and about June, they often kill quite large twigs. When scores of these posts are at work on a tree, the whole tree soon looks brown and burned and presents a very unpleasing sight.

The Carpenter Worm. Early last fall our attention was called to certain oak trees that were dying. An examination showed that the trees were badly riddled by the carpenter worm. The greater part of the cambium was destroyed and the larval burrows were crowded throughout the wood. Later we found that scores of other

trees were badly infested, mostly with young larvae. Their presence was indicated by the exudations from the tree and the castings of the larvae. The young borers work mostly in the cambium and sapwood, sometimes making rather long winding chambers but more often eating out a large irregular shaped cell and loosening large pieces of the bark. After they have attained considerable size they bore deeper into the wood.

As some of the trees in Palo Alto were killed and others were seriously threatened, some of the students in our forestry class coöperated with the city of Palo Alto and all of the badly infested trees that stood in the streets were treated. The entrance to the burrow when stopped up was opened with a knife or chisel and a small pipette full of carbon bisulphid was introduced into the burrow and the entrance closed by being plastered over with mud. This killed all the larvae.

The Oak Tree Cerococcus. The underside of the large limbs and smaller branches of many of the live oaks is covered over with a slimy mould. For a long time this was supposed to be only a mould growing on the tree but it was found that its presence there was due to the fact that a peculiar scale insect, *Cerococcus ehrhorni*, was there secreting a honey dew in which this fungus grows. When these insects are present in such numbers as they frequently are, they must considerably impair the vitality of the tree.

If the oak tree finally succumbs to the attacks of some or all of these pests, it is immediately attacked by an army of other insects that live on the dying or dead wood. The Scolytidae come first, then the Buprestidae, Cerambycidae, and other wood borers, so unless the wood is protected it is soon destroyed.

Fungus Disease. A peculiar disease has been doing very serious damage to the live oaks in the Santa Clara Valley during the past fall and winter. On many of the trees a small patch of leaves would begin to turn brown, this area would rapidly spread, sometimes covering one side of the tree, rarely spreading over the whole tree. Seen from a short distance, these patches looked exactly like a fire had been burning under the tree and had leaped up and burned the leaves. Many trees lost most of their leaves in this way but as soon as the old leaves were off, new ones appeared and the trees seem to be recovering from the attack.

Dr. Meinecke, who recently examined trees affected in this way, believes the disease to be due to a fungus working in the leaves and probably in the branches.

FRUCTIFICATION OF THE FIG BY BLASTOPHAGA[1]

By G. P. RIXFORD, *U. S. Department of Agriculture, Bureau of Plant Industry.*

The subject of this paper is both botanical and entomological and to make it clear, it is necessary to mention some of the botanical characteristics of the fig.

Botanists are now generally agreed in the acceptance of the ideas of Linneus and others that the caprifig is the staminate form and the Smyrna and all the common figs in cultivation the pistilate form of a dioecious species. Hegardt reached this conclusion as early as 1844 and this view is now generally accepted.

The fruit of the fig tree is not a fruit in the sense in which we regard the apple, peach, etc., but is what is known to botanists as a receptacle, upon the inner surface of which are arranged hundreds of unisexual flowers. At the apex of the receptacle is an opening which in the young fruit is closed by a number of scales or imbricated bracts. The blossoms of the fig tree are therefore never seen except by opening the fig. The flowers thus being effectually cut off from the outer world, there is no way by which the pollen from the male flowers can reach the female flowers, except by the assistance of some outside agency. In this case the medium of conveyance is the female *Blastophaga grossorum.*

Crops of the Fig Tree. All the female fig trees, both of the Smyrna class, the fruit of which never matures without pollination, and the other large class which does not require pollination, have two well defined crops. The first pushes from the old wood and is the first to appear in spring, ripening in July and August and in the south of Europe are called Brebas, *figues fleurs* or *figues d'été.* The next, which is the main crop, called in France *figues d'automne*, spring from the axils of the leaves of the new wood and ripen in summer and fall.

The crops of the male or capri tree are two well defined and a third which is in doubt by some authorities. To these for convenience the Neapolitan names, mamme, profichi and mammoni have been applied. The first or mamme crop forms in late summer on the wood of the current season and the Blastophaga from the preceding mammoni oviposits in them when they have reached the size of filberts. By December these are the size of small walnuts and change but little during winter. The insect hibernates in them in the larval condition and will endure a temperature of 20 degrees without injury. As-

[1] Read at the meeting of the Pacific Association of Scientific Societies held at Berkeley March 31, 1911.

the weather becomes warm in spring, the wasps develop rapidly and in April are ready to issue. At this time the spring or profichi crop on the same or other capri trees are in a receptive condition. This crop grows in clusters on the old wood at the extreme ends of the branches and, unlike the mamme which is nearly spherical is much larger and usually has a pronounced neck. It is produced in enormous numbers—many times greater than any other crop—a wise provision of nature as it is the one which is most abundantly supplied with pollen and also the one which is exclusively used to pollinate the main Smyrna fig crop.

The third or summer crop of the capri tree, known as mammoni, unlike the others, pushes from the axils of the leaves on the new wood and matures from September to the middle of November. The only purpose of this crop seems to be to carry the Blastophaga through the late summer and fall months and to produce seed. Dr. L. O. Howard, Chief of the Bureau of Entomology of the U. S. Department of Agriculture, has doubts as to the existence of three distinct crops of caprifigs and with good reason, for at times and in some climates belated mammoni hibernate with the mamme. The chief difference between the two is that the former contains a well defined cluster of staminate flowers, while in the mamme no male flowers have been observed. These hibernating figs are so similar in form and general appearance that without cutting them open it is difficult to tell them apart. They can be found on some capri trees at the present time. Last Saturday the writer in company with Prof. Harper of the University of California found considerable numbers of them on a tree at Niles. When their habits are better known they may prove to be an important source of pollen for the early crops of Smyrna and other breba figs, which for want of pollen often fail to develop. The Blastophaga from these oviposit in the winter crop and thus the cycle of the yearly life of the insect is completed.

The Fig Flowers. Count Solms-Laubach and Dr. Meyer, the German botanists, Olivier the Frenchman and Casparina, Gallesio and Pontedera, the Italians and later Dr. Gustav Eisen, author of the leading treatise on the fig in the English language, are all agreed that there are four kinds of flowers in the fig. It may seem presumptuous to take exceptions to this array of distinguished authorities, but it is nevertheless a fact, easily demonstratable with the abundant material now accessible in California, that there are but two kinds of fig flowers, namely pistillate and staminate. These authors enumerate the four kinds as the male and female of the caprifig, the regular female flower of the Smyrna fig and lastly the female flowers of the Adriatic figs which some of them contend have imperfect stigmas and cannot

pollinated and therefore call them mule flowers. Pontedera and Gadesio call such flowers *fico mula* and *fico semi-mula*, the latter a few of which are susceptible of pollination and the former not at all. This idea has become so fixed in the minds of some horticulturists that they are calling this class of figs "mule figs," a positive misnomer and entirely unwarranted by the facts.

The staminate flowers of the caprifig are arranged in a zone or cluster at the upper part of the fig, just within the eye. The remainder of the receptacle is filled with gall flowers which are nothing more than female flowers, the pistils of which are modified for the purposes of the female Blastophaga. The styles of these flowers are short and thick compared to those of the Smyrna and other female figs and are provided with a duct down which the female wasp pushes her ovipositor into the ovary where she deposits the egg. These styles are surmounted usually by forked stigmas, the surfaces of which are provided with the usual cells or glands and the viscous coating to which the pollen grains adhere. With sufficient magnifying power the pollen tubes can be seen pushing their way from the surface down through the cellular tissue into the ovary. The gall flowers of all caprifigs are alike except for slight variations in the shape of the stigmas.

We now come to the regular female flower of the Smyrna fig, upon the character of which all are agreed. The style is long and slim two or three times longer than the style of the caprifig and this is the reason that it is unsuited for the purpose of the insect. It is divided at the summit usually into two stigmas and they appear to be identical with those of the Adriatic class to which belong all those figs which reach an edible condition without pollination. The stigmas of the latter, the books say, are mostly malformed and cannot be fertilized.

To show how erroneous is this conclusion it may be mentioned that during the spring of 1909 the writer by applying the Blastophaga to the so called "mule figs" in more than forty cases found that in every instance heavy fertile seeds were produced and in as large proportion as in the Smyrna fig. From these seeds thousands of plants were grown at the U. S. Introduction Garden at Chico. It is believed that such plants will be the means of producing some interesting varieties. The breeder does not have to wait long for results for most of the seedlings bear fruit at the age of two and three years.

A striking instance of the fertilization of common figs occurred last year at Loomis, Placer county, where a fruit grower had grafted a portion of an Adriatic tree with Smyrna scions. The Smyrna branches set large quantities of figs and wishing to secure a crop the owner hung caprifigs in them containing Blastophaga ready to issue. Some of the wasps entered the Adriatic figs on the ungrafted part of the

tree. The writer secured three mature Adriatic figs which showed by their larger size had been entered by the wasps. These three figs contained by actual count 4800 heavy, fertile seeds, or an average of 1600 for each fig—certainly a good crop for a "mule fig" which according to some writers will not breed.

In this way fertile seeds can be secured from all kinds of our cultivated figs and the breeder has complete control of such crosses and can with considerable confidence expect to perpetuate desirable hereditary characteristics in his seedling trees. It is found, however, from experience that about one-half of such seedlings are staminate trees. The process is exceedingly simple. A twig is selected with a number of figs from three-eighths to three-quarters of an inch in diameter, which is the receptive size in most varieties. Drop a caprifig with Blastophaga ready to issue into a paper bag and tie it tightly over the twig and the insect will do the rest. At the end of two or three weeks remove the paper bag and replace with one of mosquito netting for protection against birds and to prevent the ripe dried fig from falling to the ground.

Caprifig Seeds. The mammoni crop of the capri tree is the only one which has been observed to produce seeds and then only in small numbers. The obvious reason is that it is pollinated by the Blastophaga of the preceding profichi crop. The profichi itself yields no seed, because the mamme figs preceding it have no pollen, although the pistils are provided with receptive stigmas.

Solms-Laubach found 20 seeds in 40 mammoni figs and reached the conclusion that not more than one flower in 2000 was a perfect female flower, all the others being gall flowers, incapable of fertilization. The writer has found as many as 75 fertile seeds in one fig and from a large number of mammoni seeds secured last summer, young plants are now being grown at Chico. From careful observations the writer has been forced to the conclusion that all gall flowers are perfect female flowers and susceptible of pollination and that most of them are pollinated, but if the Blastophaga deposits an egg in the ovary, the resulting larva, would prevent the formation of the ovule and if formed would be eaten or otherwise destroyed. The seeds therefore found in the mammoni figs are from those flowers in which the insect failed to oviposit.

There seems to be some connection, not yet well understood, between the seed and the secretion of sugar and coloring matter. The pericarps and floral envelopes of the seeds in mammoni fig are succulent, sweet and generally of a pink color, while all parts of the gall flowers containing Blastophaga are white and quite dry, the difference in appear-

be so great that the seeds can be readily picked out with a pair of forceps from the mass of galls by their juiciness and color.

As further evidence that all the flowers in the mammoni fig are perfect female flowers, some of the persistent styles were taken from fertile seeds and others from galls containing fully developed Blastophaga in the same fig and placed side by side under the microscope and were found to be identical in cellular structure and in every other respect. The writer is therefore satisfied that the stigmas of the caprifigs are equally as susceptible to pollination as are those of the female figs, and in fact are so pollinated but fail to produce more than a few seeds for the reason given.

When the Blastophaga enters the caprifig its stamens are in an undeveloped condition and will not be ready to shed their pollen until about two months later, that is at the time when the next generation of wasps is ready to issue. It is therefore impossible for a fig to pollinate itself. Here then is a striking instance of one of nature's methods of preventing self fecundation.

Life of the Blastophaga. The beneficent insect upon which depends absolutely the whole Smyrna fig industry was sent over to the United States from Northern Africa in 1899 by Mr. Walter T. Swingle of the Bureau of Plant Industry of the U. S. Department of Agriculture. He succeeded where others had often failed by confining his efforts to the winter generation and by the ingenious device of wrapping each caprifig in tinfoil to prevent evaporation. Mr. Swingle is entitled to full credit for his successful efforts, notwithstanding the fact that the Blastophaga was already here, having been accidentally introduced with fig trees from the South of Europe about 1865, but not known to orchardists until about three years ago, having been as far as known confined to an isolated tree ten miles west of Modesto.

In April in the warm valleys of California, the wasp which hibernated in the larval form during the previous few months reaches maturity. The male leaves the gall first. He moves about the interior of the fig and finding a gall containing a female, gnaws a hole through the corex at the base of the style and inserting his long, slim, abdominal projection, fertilizes the female while still in the gall. The female enlarges the opening and sometimes makes another, usually at the base of the style, probably because it is the point of least resistance. In from 22 to 48 hours she comes out, reaching the open air through the cluster of male flowers, the anthers of which at this time have burst and are shedding large quantities of pollen. She is frequently so loaded that she is unable to fly until she divests herself of much of it in the same way that the common house fly cleans itself. After being relieved of part of the load she flies to the nearest fig and if found to her

liking, immediately seeks the opening at the apex. At this time the figs are hard and from a quarter to three-quarters of an inch in diameter and the eye is closed by the overlapping scales. With her powerful mandibles she sometimes is obliged to cut away a portion of one of them to effect an entrance, but usually she is able to push her head in and after a struggle of sometimes five minutes or more pushes her body down the zigzag way to the interior of the fig, leaving her wings behind.

While one wasp is probably sufficient to fertilize a fig, where they are very abundant as at the Maslin orchard at Loomis, it is not unusual to find a dozen or fifteen in one small fig and as many more in a struggling mass trying to get in, often the cluster of wings radiating from the eye like the plumes of a feather duster. If the caprifig from which the wasp has issued has been hung in a Smyrna tree she enters a Smyrna fig and then finds she made a mistake, as the flowers are of such shape that she cannot oviposit in them, and after wandering about in a vain effort to dispose of her eggs, in this way doing her useful work of fertilizing the female flowers, in most cases crawls out. When the weather is warm, say 90 to 100 degrees, the insects are very active and come out of the caprifig with a rush. The writer has seen 40 come out in one minute. The issue takes place almost entirely in the forenoon, except a cold windy morning is succeeded by hot sun in the early afternoon, then a considerable number come out. The movement depends much upon the weather. During cool windy mornings very few issue, but if the next morning is warm, calm and sunny a great rush occurs. The wasps continue to issue from a single fig for a week or ten days and from various trees for two to three weeks. After the females have left the fig most of the males soon follow and being wingless drop to the ground like the females from the Smyrna figs.

Every Smyrna fig not entered by the Blastophaga dries up and falls from the trees. The same is true of the caprifig. In a few days the caprified fig undergoes a remarkable change. It begins to increase rapidly in size, becomes smooth by a lessened prominence of the ribs and losing its pea green color, assumes a decidedly pruinose tinge, this being true also of the caprifig.

There are still obscure problems to be solved in connection with the fructification of the fig and it would be gratifying if some of our skilled cytologists could be interested. One such problem is to determine why the first crop of certain figs reach an edible condition without caprification, while the next one never matures without it. One of these varieties is the white San Pedro and another is the Gentile, the first crop of the latter, however, does not entirely fail without pollination, but the crop is much increased by the application of the Blastophaga.

Outlook for the Fig Industry. The outlook for the Smyrna fig

industry in California is extremely promising, due principally to favorable climatic conditions, and is rapidly spreading to all parts of the great interior valley. The climate is not at all inferior to that of the Smyrna district of Asia Minor, where the bulk of the finest figs of the world are now produced. The valley of the Meander, the seat of the great Smyrna fig industry, has a much moister climate and in some respects is inferior to that of portions of California. The rain fall is three or four times greater than that of the central San Joaquin valley, where in this state the industry has at present its greatest development. The rain however falls mostly from November to April with occasional showers and dew in summer, making irrigation unnecessary. One drawback in that country is that once in three or four years a frost occurs which is severe enough to destroy the caprifigs, when the growers are obliged to draw supplies from the frost free islands of the Mediterranean.

The ideal climate for Smyrna fig culture is one in which the winters are mild enough to permit the Blastophaga to live through without injury and freedom from early fall rains. The Smyrna figs ripen and dry on the tree in September, October and November and then fall to the ground, only the large figs require further exposure to the sun. Dry weather at this period is therefore indispensible. As these conditions prevail nowhere else in the United States, except in California and a part of Southern Arizona, these would seem to be the regions in which the industry will have its greatest development.

ECONOMIC ENTOMOLOGY FROM THE VIEW POINT OF THE SANITARIAN

(Abstract)

By W. B. Herms, *University of California*

Entomology as a specific science was not known to our grandfathers, and the economic application as related to horticulture in the control of plant diseases is a development of this generation, while the application of entomology in the control of human and animal diseases, in public hygiene and sanitation, is the development of the last very few years. The new science of Medical Entomology is perhaps barely five years old and we, here on the Pacific Coast, have had a large share in its systematic development. The unique position geographically which California in particular occupies with reference to the entire world provides an opportunity for observation and experiment not

found elsewhere, and the climatic conditions afford a favorable basis for control when the life history and habits of the responsible disease vehicle are known. The following quotation from the letter of a prominent eastern physician indicates the tenor of a number of letters received from interested observers, viz., "It looks very much as if the Pacific States are destined to lead the nation, yes, the world, in this extremely important and direfully neglected work." Perhaps no state in the nation needs to protect itself more against the introduction of disease than does California because it is the goal of many thousands of health seekers and other visitors, but this it can do more easily and more successfully than any other state, on account of its natural resources conducive to health and vigor. The greatest menace of course is that of the parasitic tropical and semi-tropical diseases which are insect borne, owing to the fact that these diseases can thrive here almost without exception if once introduced.

The economic entomologist if also equipped as a sanitarian and parasitologist, has a greater opportunity by far to stay the advance of such diseases as malaria, yellow fever, bubonic plague and the like, than has the sanitarian without the entomological and parasitological training. Manifestly the person who is familiar with the habits of the Anopheles mosquito in addition to knowledge of malaria and the causative micro-organism, has a far greater advantage in controlling the disease. The same holds true for yellow fever, and bubonic plague as distributed by fleas, etc. As the successful economic entomologist is not merely a student of systematic entomology and morphology, he must indeed be proficient in chemistry and mechanics, so the Medical Entomologist must cover also a broader field and include in addition to the above, the greater portion of the field of Parasitology in a restricted sense, i.e., must be familiar with the habits of the pathogenic organisms carried, the manner in which insects become infected and in turn how these infect other animals and man.

With the scope of our subject pretty well defined it might be suggested that this is not a branch of economic entomology at all, and indeed, the sanitarian may find little sympathy at the hands of the usual type of entomologist, perhaps because the mere matter of human life and happiness is involved,—that this field does not concern itself with the tree and its fruit, and the vine and its product. However that may be, and I do not ask for less attention to the horticultural side of economic entomology, but I do plead for more positive attention to the sanitary and hygienic phase of the subject. Surely where preventable disease is concerned such as malaria, a good economic case can also be made. Business is far more keenly affected by malaria and mosquitos than we may at first thought suspect. There is per-

other disease that quite so successfully undermines a man's efficiency, his vigor, and good spirits. Victims of malaria whether employed in the orchard or vineyard, or in the wheat field, or at dredging or in construction, are only giving half in return for their wages. The value of real estate is greatly affected. Situations otherwise ideal for permanent house sites or summer homes are made practically uninhabitable by the presence of this disease. Malaria is always a great drawback to colonization,—great areas offering the most fertile soil and best of climate, affording otherwise the best of health conditions, are made of little value because of this disease, an infection which can be controlled almost absolutely and at a small relative cost. The malaria crusades under the writer's direction during the past year gave protection at the rate of 40 cents a day per square mile, with a reduction of malaria in the first season by approximately 45 per cent.

Once the real estate booster and colonizer gets the right view point things will change. The writer had to feel much opposition at first from certain classes of people who feared that publicity would do the town an injury. The attitude is changing rapidly so that now many who were once opposed, feel that it is a good advertisement to make known that the town of so-and-so is actively engaged in fighting malaria. And certainly it is, for everybody had already been well informed of the fact that this disease was prevalent there, notwithstanding all statements to the contrary.

The time will unquestionably come, indeed is already here, when the sanitary officers of a community will be required to have a knowledge of insect control, as far as disease carriers such as mosquitos, flies and fleas are concerned.

DISTRIBUTION OF ECTO-PARASITES

(Abstract of paper presented by PROFESSOR V. L. KELLOGG)

In this paper Professor Kellogg called attention to some of the interesting problems in connection with both the geographic and particular the host distribution of the various insect ecto-parasites of birds and mammals. Specific illustrations of these problems were drawn from the conditions presented by the Mallophaga, a group to which the speaker has given special attention for many years.

One of the most striking problems in this connection is that of the occurrence on two or more hosts of absolutely distinct geographic ranges of common Mallophagan species. For example, there are many species of Mallophaga which are common to European and American

birds of different although usually related species and genera. Some of these cases can be explained by a circumpolar range and hence possible contact of the hosts, but in most this explanation is unavailable. Indeed in most of these cases the host individuals of the distinct American and European species are absolutely restricted to their Old World and New World habitats and never by any chance come into contact with each other. But there is no question of the identity of Mallophagan species found on these hosts. The speaker's solution for this problem is that the parasite species of the different but related host species has persisted unchanged from the common ancestor of the two or more host kinds.

The speaker pointed out that these problems of distribution of the ecto-parasites, which always have been of large biologic interest and importance, are now assuming, in the light of the discovery of the disease-disseminating possibilities of the parasites, a new interest.

THE INSECTICIDE INDUSTRIES IN CALIFORNIA

By C. W. Woodworth

California stands foremost among the states in the use of insecticides. Our annual bill for these materials amounts to somewhere in the neighborhood of a quarter of a million dollars. More than half of this money is sent out of the state but we possess a large and growing insecticide industry which is reaching out for other markets and it is likely that in the near future California will be exporting more insecticides than are being imported. Indeed, I confidently expect to see California take a leading place in the manufacture of insecticides.

In this paper I do not propose to discuss either the technical or the commercial aspects of this industry, interesting as these phases of the subject might be, but rather the relation this industry bears to economic entomologists. I am not sure we all appreciate the tremendous influence the manufacturers and dealers of insecticides are exerting. They are in touch with a hundred growers where an Experiment Station Entomologist reaches one. They have the last word when they furnish the goods just as they are about to be applied. Their advice will go far to confirm or to counteract our recommendations.

The quality and uniformity of the insecticides are factors of highest import and they are dependent solely on the care and honesty of the manufacturer or dealer.

The appreciation of the need of close co-operation is responsible for one of the distinctive features of this association. While the

American Association of Economic Entomologists is almost strictly an organization of investigators, the Pacific Slope Association numbers among its charter members and specifically recognizes in its constitution, the manufacturers of insecticides.

One of the most important results of this affiliation has been the enactment of the California Insecticide Law, a measure demanded by our leading manufacturers as well as by the fruit growers and which takes advanced ground regarding the guarantee of the quality of the goods offered for sale in this State. This law is sure to have a large influence upon the legislation of other states, and if our prediction of the dominance of California insecticide industries is well founded, it will have a direct and positive influence upon the economic entomology of the Pacific Coast.

The distinctive feature of the California Law is the requirement of the statement on the label of the composition of the insecticide. The manufacturer or dealer must guarantee, and the law requires under severe penalties, that he honestly guarantees, the composition of the insecticide he offers for sale.

The attitude of entomologists all over the country towards secret preparations has been one of suspicion and distrust and the influence of the dealers in such goods have in consequence been antagonistic, often in the extreme.

Entomologists have very generally held that secrecy is prima facia evidence of fraud. Many cases have been investigated and rarely have manufacturers of these preparations given full money value for the material sold. The California law strikes at the root of the evil and has decreed that hereafter there shall be no secret preparations offered for sale in this state.

The enactment of this law has driven out of the market the preparation known as I X L compound, which has been sold to growers in every part of the state and in very large quantities for more than a score of years,—a material fraudulent not because it was without insecticidal value but because every means was used to give an exaggerated estimate of its value, so that it was sold for far more than it was worth and was applied at a strength at which it could serve no useful purpose. The preparation was advertised as being at the same time patented and secret. As soon as the law required an honest statement of its contents, it ceased to be offered to the public.

The number of preparations of an entirely fraudulent character on the California market is not large. There are several hundred manufacturers of insecticides, large and small, in California and very few preparations have been withdrawn from sale since the law went into effect, though in many cases the composition has been changed fundi-

mentally when the statement of composition was required. The chief benefit of the requirement of the statement of composition in the proprietary preparations is that the dealer can no longer safely make extravagant and therefore fraudulent claims of the efficiency of the preparation he is offering for sale. Many of the smaller manufacturers have urged that they were being compelled to divulge a valuable trade secret to their competitors but in no case, after the necessary formula was in my hands, did there appear any substance in any of the compounds as having insecticidal value which was not already a matter of common knowledge, and the secret, if there was any, lay in the per cent used of the different ingredients,—whether, for instance, A used 5 per cent of snuff in his flea powder.

The only real basis for objection lay in the fear that B could not sell his perfumed pink gasolene for ten times as much as he could charge for the ingredients, or that C could not sell vinegar and water for head lice at twenty-five cents an ounce.

Such sales border so close to downright frauds that arguments of this character appeal very strongly neither to entomologists nor to consumers, and if one has built up a trade for crude carbolic acid at several times its value by calling it "Lousene" or any other fanciful name, it has been accomplished by leading the purchaser to think that he is getting something better than carbolic acid when he buys the can with the picture label.

All manufactuers must now sell their insecticides for what they really are and a long step has been taken towards making the entomologist and dealer harmonize their recommendations.

The knowledge of the practical value of cyanide for orchard fumigation dates from a bulletin issued by the California Experiment Station.

Cyanide constitutes the largest single item of expense for insecticides in this state. None of it is made in California, and practically all of it comes from the firm of Roessler and Hasslacher and Company of New York. This material has varied very greatly in composition during the years fumigation has been practiced in California. It is at present of a higher grade and more uniform composition than in the earlier days. The acid used in generating the gas is all manufactured in California and is as large in quantity though cheaper in price than the cyanide. There are two large plants manufacturing the acid, one the American Agricultural Chemical Company near Los Angeles making the acid from crude sulfur, which is peculiar among the chemicals by being almost chemically pure. The other, The Mountain Copper Company, with a plant near Martinez, that make the acid as a by-product, but produces, nevertheless a very high grade of acid

There has been much complaint in years past as to the quality of the cyanide and more particularly regarding the acid, doubtless sometimes with justice but more often the trouble has not been with the chemicals used.

Next to the cyanide, the arsenicals take the most prominent place among insecticides. Outside of California the arsenicals easily hold first place. The United States insecticide law set definite standards for Paris Green and lead arsenate and did not mention by name any other insecticides.

Until within the last five years all the arsenicals used in California came from the East. Now the California Spray Chemical Company manufactures lead arsenate and zinc arsenite and supplies the major part, not only of the California market, but very largely also the Northwest.

The organization of this company came about because of the need of a specially insoluble grade of arsenate of lead, such as none of the Eastern manufacturers would supply, and which they are now only beginning to compete with. In most regions the danger to foliage is not so great as in the Pajaro Valley and therefore does not require this degree of insolubility.

All of the larger Eastern manufacturers of arsenicals still sell their goods in this state, probably in as large quantities as they did before the organization of the California Spray Chemical Company, since there has been a very great increase in the consumption of arsenicals following the Codlin Moth investigation conducted by the University in the Pajaro Valley.

Lime sulfur as a spray mixture originated more than a quarter of a century ago in California and was used in this state in large quantity for many years before its use spread to other states. For a long time it was the largest item of Insecticide work in this state and even yet may be more important than the use of the arsenicals. It is very difficult to obtain a reliable estimate of the amount used since it is still very largely a home made preparation. The lime used is all of local manufacture and the sulfur imported, largely from Japan.

Both of these materials are used quite extensively for other than insecticide purposes and but for this reason it would be very easy to get an estimate of the amount used in making this spray.

The commercial production of lime sulfur originated not in California but in the East and was introduced into California through the business enterprise of the California Rex Spray Company erecting an extensive factory at Benecia. Subsequently the California Spray Chemical Company began to manufacture this spraying material

also, first for the strictly local trade, but now extending their market even into other states.

Through the efforts of these companies the use of the home made preparations have been largely replaced by the more uniform commercial product with very satisfactory results.

The competition of these two companies has resulted in a cheapening of the price and their rivalry has kept up or even increased the density, all to the benefit of the consumer.

Distillates of California petroleum have played a rather important role in the insecticide operations in this state. The refineries have from time to time, sold special spraying oils, but most of the spraying has been done with ordinary commercial grades of kerosene, or the cruder stove distillate, sometimes with the lighter grades of crude oil just as it comes from the ground.

In the past there have been many who have manufactured emulsions from distillates, chiefly for local trade. The only firm now making a commercial emulsion and the only one who has manufactured it for sale over the state generally is the Bean Spray Pump Company of San José, under their trade name "Buggo."

The R. R. Rogers Chemical Company of San Francisco were the first to put out, and, I believe now the only firm, manufacturing a true miscible oil which they sold under the name of "Spra-mulsion."

The use of power spraying outfits producing a mechanical mixture of a very satisfactory quality has prevented the large use of these emulsified oils, and the smaller users have not become sufficiently acquainted with the convenience and satisfactory character of these commercial products. Undoubtedly the future will see a greatly increased use.

Tobacco is coming to be a more important insecticide in California but the local source of supply is very limited. All of the commercial nicotine preparations are imported from the East. Forty per cent nicotine sulphate, sold by the Kentucky Tobacco Corporation, has become the standard, particularly since the insecticide law has come into effect and the dealers are learning that the ordinary nicotine solutions are very unreliable in composition, possibly due to the decomposition of the alkaloid.

The high nicotine content of California tobaccos, which stand in the way of the commercial growing of this crop in the state, should indicate that there was a field for the growing of tobacco for this special purpose, though at present the Eastern nicotine is a by-product.

Nicotine sulphate is used largely both for tree spraying and as a dip for animals.

Most of the animal dips are made from crude carbolic acid and

same material has considerable use as a tree spray. When prepared and sold as a dip, the regulations of the U. S. Bureau of Animal Industry have operated to secure a fairly reliable standard but it has only been since the insecticide law went into effect that dealers have known what per cent of cresylic acid was present, and this has varied from 5 40 per cent.

Under these circumstances it is not at all surprising that experimenters have generally considered this material too unreliable to recommend nor that the results last year in the Santa Clara Valley were so irregular.

There are quite a number of local manufacturers; (I will not attempt to name them) compounding carbolic insecticides. The crude material and a good proportion of the preparations are shipped from the East. Entomologists have neglected very largely this cheap and efficient insecticide, leaving it to compounders of proprietary dog soaps, dips, sprays and lice killers, both liquid and powders, to exploit its use.

There is an important and very largely neglected field for the economic entomologist in the study of the remedies to be used on our domestic animals and in what are known as household remedies. By far the larger number of the California manufacturers of insecticides are compounding these preparations. Many of them admit that they have no practical knowledge of the relative efficiency of their compounds, that they are ready and anxious to make any change that experiment may indicate advisable in their formulae. Clearly here is an open field for our efforts of no small magnitude, since the aggregate sales of these preparations is much larger than generally appreciated.

We have already made some progress in the study of flea powders, of which scores of preparations are on the market showing a very great variation in efficiency. Most of these powders are compounded in the state.

Insect powder of the very highest quality is grown and manufactured by the Buhach Producing and Manufacturing Company of Stockton. All the other insect powders and compounded flea powders are imported, or made up from imported ingredients.

To this class of household insecticides belong the many preparations for lice on human beings which are so much less prevalent than a generation or so ago, due to the almost universal and immediate application of remedies,—for bed bugs, which, though nowhere as prevalent in California as elsewhere, are accountable for a large sale of remedies,—for cockroaches, which are coming to be very annoying about San Francisco,—for houseflies, which are almost omnipresent,—lotions for mosquito and flea bites,—remedies for clothes moths and finally and by no means the least, the ant poisons, which have appeared

in great variety, especially since the spread of the Argentine Ant to so many parts of the state.

The great desideratum is the improvement and standardization of the great host of what may be called the minor insecticides. Those that are used in the spraying of orchard trees have been reduced to a good degree of uniformity, due to the work of the economic entomologists and the use of these preparations correspondingly enlarged as the users appreciated more fully their reliability.

The California insecticide law will go far to standardize the other insecticides by giving publicity to their composition, provided that we contribute our share in the study of their relative efficiency.

THE PETROLEUM FLY IN CALIFORNIA

By D. L. Crawford, *Stanford University, California*

(Printed in Pomona Journ. Ent., Vol. IV, No. 2, May, 1912, pp. 687–97.)

DIABROTICA VIRGIFERA LEC. AS A CORN ROOT-WORM

By C. P. Gillette

Diabrotica virgifera Le Conte; Trans. American Entomological Society, Volume II, page 59;

Diabrotica filicornis Horn: Trans. American Entomological Society, Volume XX, page 94.

The last week in July, 1909, a neighbor told me that his sweet corn was being killed by a little grub boring in the roots. A week later I went to examine the corn and found the adult beetles of the above species abundant, resting on the leaves and stems of the corn and quickly taking wing when approached. The grubs had practically all left the roots but the injuries to the roots and crowns were everywhere present, very few plants escaping the attack. The owner said there were plenty of grubs in the roots during July. Figure 1 of the accompanying plate was drawn from a corn stalk taken by Mr. C. C. Bragg on July 12th of the following year and fairly represents the injury that the larvae do.

On July 2, 1910, I received a card from Mr. R. C. Aiken, of Loveland, Colorado, stating that fully one-third of his sweet corn was practically dead from the attacks of a small white worm in the roots. Mr.

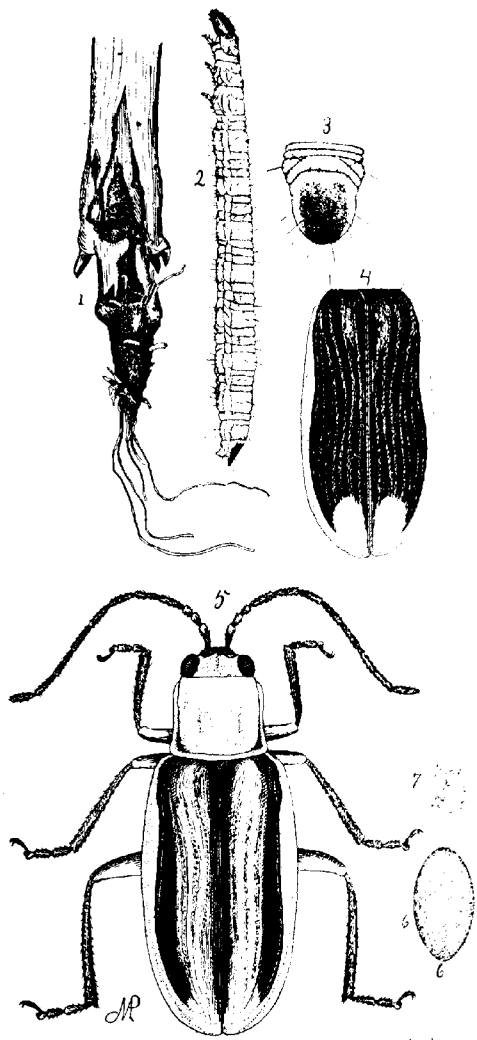

PLATE 9. *Diabrotica virgifera* Lec.; 1, Corn root attacked by the larvae, [illegible] size; 2, larva; 3, dorsal view of last segment of larva; 4, dorsal view of elytra of [illegible]; 5, female; 6, egg; 7, reticulation of egg shell. Figures 2, 4, and 5 are enlarged [illegible] meters; figure 3, 16; figure 6, 30; and figure 7, 80 diameters. Original. M. V. P[illegible], Delineator.

Bragg was sent to investigate the trouble and *D. virgifera* was found to be doing the damage. Mr. Bragg spent considerable time hunting for the injuries of the beetle during 1910 about Fort Collins and was able to report it fairly common on ground where corn had been grown for two or more years in succession and, in a few instances, the injuries were very severe. During 1911, the injuries seemed to be less, though the insect has been taken frequently about Fort Collins upon corn during the late part of the summer.

This insect occurs in two forms, one striped and closely resembling *D. vittata* as shown in Figure 5; the other with the wing covers black except for the narrow yellow margins and yellow tips, as shown in Figure 4. Specimens were sent to Professor Wickham, of the Iowa State University, who determined the striped form as *D. virgifera* Lec. and the dark form as *filicornis* Horn, and stated that *virgifera* is known from New Mexico, Arizona, and Sonora, while *filicornis* is known from New Mexico. I have not been able to find any references to either of these insects from other localities and the species was not represented in our collection here until taken in the patch of sweet corn mentioned above.

It did not seem possible to me that these two forms, with some intergrading in the color markings, could represent two species, as they occur in practically equal numbers together in all cases where we have observed them. Furthermore, the striped form had every appearance of being the female beetle and the black form, the male, and the two forms have frequently been taken *in copula*. Late in the summer, the striped form was found to be full of eggs, whereas ova never developed in the dark form, so I think the conclusion is safely drawn that *D. filicornis* Horn is the female of *D. virgifera* Lec. The antennal differences as given in the original descriptions seem to be constant for the two sexes.

Mr. Bragg followed the habits of this insect quite carefully in the field but was unable to find the eggs out of doors. Beetles brought into the laboratory, however, deposited eggs quite freely in test tubes. The eggs are pale yellow in color and measure about .65 mm. in length, .45 mm. in width, and are finely reticulated on the surface. See Figures 6 and 7. The larva is pale yellowish in color, 11 mm. in length when fully grown, and has a conspicuous black anal plate. See Figures 2 and 3. The length of the beetles varies little from 5 mm.

It seems certain from the observations that we have already made that the insect is single-brooded, and has practically the same life history as *D. longicornis*. This being the case, the very simple remedy will be, not to grow corn after corn where this insect has been quite common the preceding year.

CLEONUS CANESCENS LEC. AS A FRUIT TREE PEST

By C. P. Gillette

This insect has been reported to me on several occasions as a pest to young fruit trees on the western slope of the Rocky Mountain range in Colorado and Utah.

On June 30, 1908, Mr. O. B. Whipple, who at that time was Field Horticulturist for the Colorado Experiment Station, at Grand Junction, reported this insect to me as injurious to the foliage of young peach trees in an orchard near Grand Junction.

On July 10th of the same year, Mr. George P. Weldon, who at that time was acting as Field Entomologist on the western slope for the Colorado Experiment Station, reported the same insect to me as de-

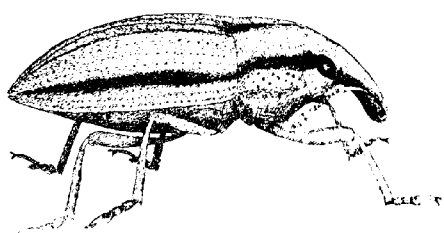

Figure 4. *Cleonus canescens* Lec.; Adult beetle enlarged 6 diameters. Original. M. A. Palmer, Delineator.

structive to the buds and young leaves of newly set peach and apricot trees.

On June 20, 1910, Mr. Weldon took the same insect at West Lake, Utah, where he found it doing serious injury to the foliage of newly set apple trees. Mr. Weldon reported that the beetles were present in considerable numbers on every tree that he examined.

On June 27th, of the same year, Mr. E. P. Taylor, who was also acting as Field Entomologist on the western slope for the Colorado Station, sent me specimens of this beetle, which he reported as being destructive to the young leaves of newly set apple trees in the Grand Valley.

It is quite evident from these records that this beetle is a native and that it normally feeds upon the native food plants of the sections where it occasionally becomes injurious to the fruit trees. In every instance where the injury was reported, the trees were newly set in virgin soil.

ITONIDA INOPIS O. S.

By E. P. Felt, *Albany, N. Y.*

1862 **Osten Sacken, C. R.** Mon. Dipt. N. Amer. 1 : 196–97 (Cecidomyia).
1890 **Packard, A. S.** U. S. Entomol. Com. 5th Rep't., p. 800 (Diplosis).
1910 **Smith, J. B.** Ins. N. J. List, p. 732 (Cecidomyia).
1911 **Felt, E. P.** Econ. Ent. Journ. 4 : 465 (Cecidomyia).

Numerous resinous cocoons of this interesting gall midge were found on the needles of scrub pine, *Pinus rigida* at Karner, N. Y., May 22, 1912, adults soon commencing to issue therefrom and numerous parasites, *Polygnotus diplosidis* Ashm., being reared May 27 and 28. An examination of shoots bearing infested needles showed distinct swellings some 7 mm. long here and there, accompanied by more or less exudation of pitch. Some of these were contiguous and produced a nearly uniform enlargement extending for several inches on twigs of last year's growth. A few larvae were found within the swellings and numerous cocoons upon the needles, most of the midges having emerged by the 27th. The habits as outlined above and the characters of the cocoon and larva to be given below, agree with those given by Osten Sacken for a species observed on *Pinus virginiana* (*P. inopis*), and as these two pines are closely allied there can be little doubt as to the identity of the insect. The midges, issuing the latter part of May or early in June, deposit their reddish orange eggs upon the needles and developing young growth, probably mostly on the latter under natural conditions. The maggots soon hatch and establish themselves in the tissues while the latter are still tender.

It is very probable that part of Packard's account of *Diplosis pinirigidae*[1] refers to this species, since we have failed to find any such resinous cocoons on needles of limbs bearing the characteristically deformed leaf clusters associated with this species. The female described in this account may be *I. inopis*, since the adult was reared from a cocoon at the proper time. It would be very easy to overlook the galls of *P. inopis*, especially if the infestation was sparse, and associate the cocoon, as Packard apparently did, with the deformed needles.

This species approaches the pitch midge, *Itonida resinicola* O. S., from which it is distinguished by its larger size, darker color and shorter antennal stems in the male. It is somewhat smaller than the western pitch midge, *I. resinicoloides* Wlms., a form easily recognized by structural characteristics. There is a difference in habit as well as color in the European *Itonida pini* DeG. The species of Itonida in general

[1] 1890 U. S. Entomol. Com. 5th Rep't, p. 798–800.

pine resemble each other and may warrant segregation in a genus by themselves.

DESCRIPTION. *Gall.* Length 7 mm., a more or less distinct, subcortical swelling containing an irregularly oval chamber some 1 mm. long and 3 mm. in diameter. These swellings are frequently indicated by more or less exuding pitch.

Egg. Length 0.5 mm., narrowly oval, reddish orange.

Larva. Length 3 mm., reddish orange, moderately stout and with a series of subdorsal and lateral, conical, fleshy processes, the latter bearing moderately stout spines. On the posterior segment these processes seem to be fused and there appear to be a pair of submedian, lobelike processes, each bearing apically a heavy, chitinous, siliconical structure supporting the spiracle, the latter being further protected by four short, stout, fingerlike processes. The head is small, tapering and remarkable because of the greatly produced, diverging processes at the latero-posterior angles; breastbone indistinct. The skin is coarsely shagreened.

Cocoon. Length 2.75 mm., diameter 1.5 mm., irregularly oval, whitish or yellowish white, becoming fuscous with the development of the insect and sometimes irregularly fluted; the anterior extremity is irregularly pointed, the insect escaping by forcing off a conical lid. The cocoons are attached by the side to the needles, to the developing shoots and occasionally to the twig.

Exuvium. Length 3 mm., the head and thorax and their appendages distinctly though variably fuscous, the abdomen semitransparent. The pupa, when escaping from the cocoon, emerges so as to expose only the fuscous portion of the exuvium. Antennae short, stout, hardly extending to the base of the abdomen, the wing covers to the third abdominal segment, the legs to the 6th and 7th abdominal segments.

Male. Length 2.25 mm. Antennae about as long as the body, sparsely haired, reddish brown; 14 segments, the fifth having the stems 1-2 and as long as their diameters, respectively. Distal enlargement nearly subcylindric, with a length 1-4 greater than its diameter, the circumfili moderately short, stout and with numerous loops. Terminal segment; distal enlargement produced, with a length 2 1-2 times its diameter, a constriction near the middle and an irregular, stout process apically. Palpi: first and second segments short, stout, irregular, the third with a length four times its diameter, moderately stout, the fourth 1-4 longer than the third, slightly dilated. Mesonotum dark brown, the submedian lines short, silver haired. Scutellum reddish brown, postscutellum dark brown. Abdomen dark reddish brown, the genitalia with a reddish cast. Wings hyaline, costa reddish brown. Halteres reddish brown, yellowish basally. Coxae reddish brown, the legs mostly a pale straw, the tarsi slightly darker. Claws moderately stout, slightly curved, simple, the pulvilli longer than the claws. Genitalia; basal clasp segment stout; terminal clasp segment short, swollen basally; dorsal plate short, very broadly and triangularly emarginate; ventral plate moderately long, broad and triangularly emarginate; style short, stout, broadly rounded.

Female. Length 3 mm. Antennae extending to the third abdominal segment, sparsely haired, reddish brown; 14 segments. The fifth having the stem 1-4 the length of the cylindric basal enlargement, which latter has a length 2 1-2 times its diameter. Circumfili moderately high, stout; terminal segment slightly produced, with a length three times its diameter, with an irregular, broad knob apically. Abdomen reddish brown, the ovipositor about half the length of the body, fuscous yellowish, the terminal lobes lanceolate, with a length over four times the width, sparsely haired; legs mostly reddish brown, otherwise nearly as in the male. Cecid a2284.

PACIFIC COAST INSPECTORS ASSOCIATION

The meeting of the Pacific Coast Inspectors Association was called to order by Mr. M. L. Dean, Horticulturist of State of Montana.

By vote Mr. M. L. Dean was made President of the Association; Mr. J. Edward Taylor, State Horticultural Inspector for Utah, Vice-President, and Mr. J. U. McPherson, Horticulturist for Idaho, Secretary and Treasurer; with J. P. O'Gara of Medford, Oregon, F. A. Huntley of Tacoma, Washington, Dr. A. J. Cook of Sacramento, California, and Prof. C. P. Gillette of Fort Collins, Colorado, as members of the Executive Committee.

Chairman, Mr. M. L. Dean, authorized the Secretary to draft the Constitution and By-Laws of the Association, subject to the acceptance at the next meeting, which place and time is to be set by the President of the Association, and at which time the matter of fees to maintain the organization will be brought up.

The organization will, also, include in its membership all persons who are interested or engaged in the horticultural inspection work, either actively or in an advisory capacity.

Being no further business, the meeting adjourned subject to the call of the President.

Salt Lake City, Utah,
June 4, 1912.

Constitution and By-Laws

Article I. This organization shall be known as the Pacific Coast Inspectors Association.

Article II. The object of this Association shall be to promote and foster the horticultural interests and inspection work of the Western States:—Montana, Utah, Colorado, Idaho, Washington, California, Oregon, Wyoming, New Mexico, Nevada, Arizona, Texas, and British Columbia.

Article III. Any person, who is employed in inspection work, either actively ex officio, or in an advisory capacity, can become a regular member of this Association upon the signing of the Constitution and the paying of annual dues.

Any person, who is connected with the inspection work in other states of the Union, may become associate members upon invitation of the Executive Committee. Associate members shall have the privilege of the Association, except holding office and voting; and they shall not be required to pay annual dues.

Article IV. The officers of the Association shall consist of a President, Vice-President, and Secretary-Treasurer; and Executive Committee made up of the above said officers and four more to be elected; and an Advisory Committee to consist of the chief inspection officer of each state represented in the Association. The shall be elected by a ballot at each annual meeting. Their services shall begin the close of the session at which they are elected, and continue for one year. The President can hold office during only two consecutive years.

Article V. The Association shall hold at least one meeting annually, at such a time and place as the Executive Committee designate. Special meetings may be called by the Executive Committee when the interests of the Association shall require it.

Article VI. The President, with the consent of the Executive Committee, shall appoint such committees as seem advisable for the best interest of the Association.

Article VII. The Constitution may be amended or changed at any regular meeting in the following manner:

1.-All proposed amendments must be filed with the Secretary at the opening of the annual meeting.

2. No amendment can be acted upon by the Association unless read by the President at first session of annual meeting.

3.-The By-Laws of this Association may be amended by a majority vote of the regular members in attendance.

Article VIII. The annual dues of the members of this Association shall be fixed by the Executive Committee subject to change at any regular meeting. The dues of the ensuing year shall be $1.00.

DUTCH INSPECTION SERVICE

We have at hand a recent communication from Dr. J. Ritzema Bos of the Phytopathological Service of Holland, calling attention to minor changes in the certificates from the form published in the February issue of the JOURNAL, pages 85 86.

The modifications in the certificate are mostly in a transposition of the data relating to destination and contents. The copy certificate is modified to contain a specific provision against infestation by the brown-tail moth, and provision is also made for numbering and the Service stamp.

Dr. Bos, in his communication, states that every consignment from Holland must be provided with a certificate, both stamped and numbered, adding that the Dutch Inspection Service must not be held responsible for shipments not accompanied by these certificates. He would also esteem it a favor if parties receiving from Holland nursery stock, which had not been inspected, would notify him in regard to the same.

GIPSY MOTH

A small colony, apparently of about three years' standing, and practically confined to a city block, was discovered recently at Geneva, N. Y. No expense is being spared and an early extermination of this out-lying colony may be expected. Such infestations may develop elsewhere, and the probability of such occurrence emphasizes the need of careful inspection.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

AUGUST, 1912

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints may be obtained at cost. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged.—EDS.

The economic entomologist certainly deserves all the credit he receives, since altogether too frequently enthusiasts in this branch of natural science are called upon to serve at a ridiculously low compensation, considering the requirements of the position. Personal notes, records of achievements and summaries of the life work of our associates are valuable stimuli to professional workers and frequently give the layman a glimpse of conditions as they exist. We print in this issue a series of memorial resolutions, feeling that the party richly deserves all of the honor conveyed or implied thereby, and yet we are of the opinion that in most cases an obituary notice with its summary of the life work, is of more interest to readers and will prove of greater historical value.

The economic entomologist is not primarily a systematist, yet he is occasionally compelled by exigencies to undertake taxonomic work and not infrequently encounters perplexing questions in nomenclature. The Entomological Code, recently compiled by Messrs. Banks and Caudell, promises to be of much service in affording a basis at least, for the settlement of troublesome problems. It is extremely unlikely, as the authors point out, that all the provisions will be satisfactory to any worker, yet it is an important step toward unifying procedure, and we trust that all entomologists will interpret the provisions of the Code in a comprehensive manner and with due regard to the welfare of Science as a whole. The authors, in undertaking this task, mostly thankless we fear, have laid their fellow workers under a burden of debt, an obligation which will become more evident with the progress of time.

This issue, following the example of some popular magazines, might be denominated our western number, since it contains the Proceedings of the Pacific Slope Association of Economic Entomologists with its valuable contributions from entomologists in that section of the country. All such matter is gladly published. It is not our intention

to issue a local Journal, whether we speak of sections, nations or even hemispheres. We take this opportunity of assuring all economic entomologists in all parts of the world that articles covering any phase of economic entomology are most heartily welcome. Several efforts have been made to secure papers from entomologists not resident in the United States and for the most part with comparatively little success. Our collaborators in Africa, Asia and Australia, to mention only a few regions, must have much worthy of publication and frequently of general interest. An international scientific Journal can be successful only through the co-operation of all and we bespeak once more the assistance of scientists stationed in distant sections of the globe.

Memorial

CLARENCE E. HOOD

WHEREAS, It has pleased God to take unto himself our beloved friend and coworker CLARENCE E. HOOD; and

WHEREAS, Our dear friend by his earnest endeavors and never ceasing efforts had already reached a prominent position in his chosen field and that the scientific investigation he was so ably carrying on will suffer greatly by his sudden and untimely death; and

WHEREAS, His lovable character and ever ready desire to help others had won for him an esteemed place in the hearts of his fellow workers; be it

Resolved, That we, his fellow entomological workers of Porto Rico will ever hold dear the remembrance of one whose friendship was held in such high esteem; be it further

Resolved, That we extend to the family of the deceased our sincere and heartfelt sympathy and be it further

Resolved, That a copy of these resolutions be sent to his family and one published in The Journal of Economic Entomology.

W. V. TOWER,
D. L. VAN DINE,
C. W. HOOKER,
R. I. SMITH,
THOS. H. JONES,
S. S. CRUMPEN.

June 26, 1912.

WHEREAS, The Board of Commissioners of Agriculture of Porto Rico has lost by death its esteemed friend CLARENCE E. HOOD; and

WHEREAS, He made a trip into Mexico in the interest of this Board, thereby placing himself in the midst of great danger, but was spared to return from the trip; and

WHEREAS, Clarence E. Hood by his love for his work and his faithful and active nature, was one of the most promising of the younger Entomologists; and

WHEREAS, His manly and lovable character had placed him high in the affections of the Board; therefore be it

Resolved, That in the death of Clarence E. Hood the Board has suffered a great loss; be it further

Resolved, That the Board wishes to especially show their appreciation and admiration for a man who put away fear, for the best results, when his work took him into danger; be it further

Resolved, That the project which he was so well prepared for, will be retarded by his sad and untimely end; be it further

Resolved, That the Secretary be instructed to send a copy of these resolutions, with an expression of their most sincere sympathy to his family; and be it further

Resolved, That a copy of these resolutions be published in the Journal of Economic Entomology.

W. V. TOWER,
Entomologist and Secretary for the Board.

June 26, 1912.

Reviews

The Plum Curculio, by A. L. QUAINTANCE and E. L. JENNE, U. S. Department of Agriculture, Bureau of Entomology, Bulletin 103, p. 1–250, 20 plates and 33 figures. 1912.

Our Federal Bureau of Entomology is to be congratulated upon having issued another comprehensive and well illustrated monograph upon an important pest. The careful study of the biology of such an insect in various representative sections of the country is invaluable because of the light thrown on methods of control. This type of work is peculiarly appropriate to a Federal agency.

This is both a full account and an important contribution to our knowledge of the plum curculio. The original description is reproduced, followed by a detailed history of the insect and a discussion of its distribution, food plants, life history, etc., the work closing with an exhaustive bibliography. Reference to the map shows that this common species is confined to the eastern and central United States and to the eastern and central part of southern Canada. The annual loss is estimated by the authors at $8,500,000. There are detailed records of oviposition showing that ¾ of all the eggs are laid within six weeks, the egg period lasting six or seven days. The larvae emerge from the fruit mostly at the end of the third week from oviposition, the insects remaining in the soil three to six weeks, most of them only four or five. This is particularly valuable since it is based on extensive studies in several localities.

The discussion of remedial measures includes a historical account of earlier methods followed by a consideration of the relative value of collecting, spraying and cultivation for the destruction of pupae. The authors hold that the older method of jarring is giving way to the more modern spraying with poisons, supplemented possibly by cultivation for the destruction of pupae. Experiments show that the latter results in the average destruction of about 33% of the insects. It is worthy of note that the one spraying for the codling moth just after the blossoms fall is a very effective treatment for the control of the curculio. The authors state that thorough spraying greatly reduces the pest in all cases, though the degree of benefit

varies widely. They find that with an abundance of insects and a small crop, thorough spraying will not produce a satisfactory amount of sound fruit. Clean cultivation and the planting of orchards some distance from woodlands or other natural harbors is of material benefit. There is also a valuable chapter upon spraying peaches with arsenicals. The authors are to be congratulated upon having prepared a standard work.

Papers on Insects Affecting Stored Products, by F. H. CHITTENDEN, U. S. Department of Agriculture, Bureau of Entomology. Bulletin 95, Parts 2 and 3, pages 19–52. 1911.

These two parts give general biologic and systematic accounts of four of the less known grain pests, namely, the broad-nosed grain weevil, *Oxyglypta taygetus* Say, the long-headed flour beetle, *Latheticus oryzae* Waterh., the lesser grain borer, *Rhizopertha dominica* Fabr., and the larger grain borer, *Dinoderus truncatus* Horn. The first named, the author regards as a permanently established enemy of dried cereal and other food products in the United States; the second is a recent introduction thus far known only in Texas, while the two remaining, though of considerable importance in tropical climates, are seldom injurious in colder countries. The author considers that we may adopt as a general standard, 2 lbs. of carbon bisulfid to 1,000 cubic feet of space, the temperature being between 65° and 75° F. and continuing the fumigation for 48 hours or more or until the odor of the gas has become entirely dissipated. The species discussed are well illustrated.

A Manual of Philippine Silk Culture, by C. S. BANKS, Department of the Interior, Bureau of Science, Manila, pages 53, plates 20. 1911.

This comprehensive, almost monographic work gives a historical account of silk culture in the Philippine Islands, a summary discussion of the silk worm, *Bombyx mori* and of the eri or castor silk worm, *Attacus ricini*, together with a brief mention of several wild silk worms. The growing of the mulberry, the selection of cocoons, the shipment of eggs and the elaboration and culture of silk also receive attention. The value of the latter is greatly increased by two plates giving the plans of a house for growing silk worms and also diagrams showing the construction of a hand silk reeling machine. There are admirable illustrations of the various silk worms in their different stages. The work is practical and should be of great service in establishing a profitable industry in our Island possessions.

Current Notes

Conducted by the Associate Editor

Dr. L. O. Howard left Washington about July 1st for a brief European trip.

Mr. Shigern Kuwayama, author of papers on the Psyllidae of Japan, died Feb. 17th, 1912.

Mr. Henry B. Weiss, has been appointed acting State Entomologist of New Jersey.

Mr. H. C. Eagerton, has been appointed extension assistant in entomology at Clemson College and Station, S. C.

Mr. R. W. C. Shelford, known for his work in entomology, formerly connected with the Oxford Museum, died on June 22nd, aged thirty-nine years.

Dr. Nettie M. Stevens, associate in Experimental Morphology at Bryn Mawr, and the author of a number of papers dealing with insect structures, died at Johns Hopkins Hospital, Baltimore, May 4th, 1912.

Mr. Nathan Banks, of the Bureau of Entomology, is in Europe for a few months and will visit several museums for purposes of study.

Professor Herbert Osborn gave the principal address at the twenty-fifth anniversary meeting of the Iowa Academy of Science, held at Des Moines, April 26, 1912. This address was printed in *Science* of July 12.

William B. Herms, assistant in entomology, has recently been promoted to assistant professor of applied parasitology, University of California.

Dr. A. W. Morrill, State Entomologist of Arizona, spent his vacation in Massachusetts in July, and visited a number of entomological laboratories in the northeastern states before returning to his work in Arizona.

Professor R. H. Pettit, professor of Entomology in Michigan Agricultural College, visited the New England States the latter part of June to familiarize himself with the work there against the gypsy and brown tail moths. He also visited the Entomological department of the Massachusetts Agricultural College, at Amherst, and of the Connecticut Agricultural Experiment Station, at New Haven.

Colonel Wm. C. Gorgas, chief sanitary officer of the Panama Canal Zone, received the honorary degree of Doctor of Law, at Johns Hopkins University, June 11th.

An act has passed the Arizona legislature, and has been approved by the governor of the state, amending the Horticultural Law, which has been in operation for the past three years. The scope of the work has been enlarged and the Horticultural Commission will hereafter be known as the Arizona Commission of Agriculture and Horticulture.

The duties for the State Entomologist have been better defined and many other important changes made. An annual appropriation of $12,000.00 is provided, and in addition an emergency reserved fund of $1,500.00 is established, to be drawn upon only in the event of the discovery of the Alfalfa Weevil in the state.

Prof. C. F. Baker, we learn through the *Monthly Bulletin* of the California State Commission of Horticulture, has resigned as head of the Department of Biology of Pomona College to accept a similar position in the Philippine Islands.

Dr. E. A. Back has resigned as Entomologist of the Virginia Crop Pest Commission and the Virginia Agricultural Experiment Station to re-enter government service as Expert in the Bureau of Entomology. Dr. Back will have charge of the Bureau's investigations of the Mediterranean Fruit Fly in the Hawaiian Islands. His address is Honolulu, T. H.

The American Association of Nurserymen, at the recent Boston meeting, adopted the following resolution:

"RESOLVED: That the report of the Legislative Committee on matters of Federal Legislation be accepted and that their endorsement of House Bill #24119 be approved, and further, that the new Legislative Committee be instructed to co-operate with the United States Department of Agriculture in urging the speedy passage of the Bill referred to, or any other bill not materially changing the provisions thereof."

Mailed August 21, 1912.